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THE MODEL ENGINEER

The MODEL ENGINEER

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14TH DECEMBER 1950 VOL. 103 NO. 2585

SMOKE RINGS

A Novel Excursion

● SUNDAY, NOVEMBER 26TH last was a memorable day for all who admired the Ivatt Atlantic locomotives of the old Great Northern Railway; especially was it so for the limited number of enthusiasts who were able to take part in the special excursion from London to Doncaster on that day. The train was hauled by British Railways engine No. 62822, the last survivor of the famous class, due to be withdrawn at the end of the trip.

In spite of a thick fog over London and the Home Counties, the departure from Kings Cross was made exactly on the stroke of 11 a.m. and was watched by a great gathering of admirers who had come to pay a last tribute to the memory of one of Britain's most outstanding locomotive designs.

The old engine, which had been put into traffic as G.N.R. No. 294 in 1905, was severely hampered by the fog and by two very severe permanent way checks in the earlier stages of the run, and she was consequently 13½ minutes behind schedule at Peterborough.

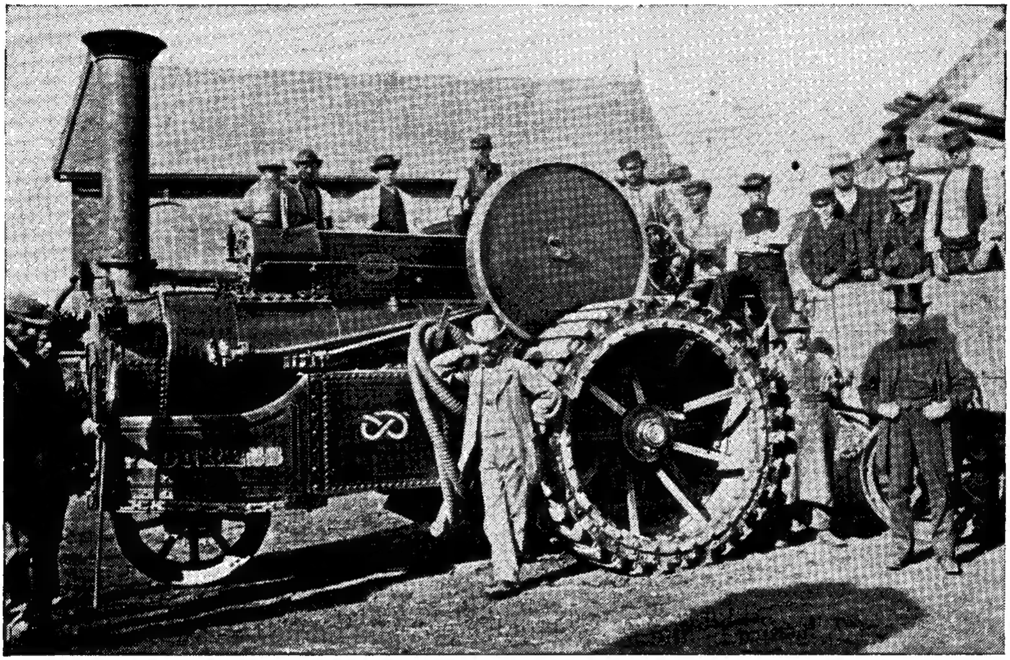
The fog had cleared by then, however, and the effect on the engine was little short of miraculous; over the remaining 80 miles from Peterborough to Doncaster, she got going to some purpose, and gave no sign of advancing age or decrepitude. The arrears of time were steadily overtaken to 11½ minutes at Grantham, 10½ minutes at Newark, 7½ minutes at Retford and a bare half-minute on stopping at Doncaster. Thus, game to the end, did she stoutly maintain the cherished reputation which she and her many sisters had built up in 45 years, and delighted all those of her admirers who counted themselves fortunate in being able to accompany her on her last run.

The next item on the programme was the presentation of one of 62822's dateplates to Mr. H. G. Ivatt, Mechanical Engineer of the London Midland Region of British Railways and son of the designer of the G.N.R. Atlantics. After that, parties of visitors were conducted through the principal shops of Doncaster Works. Out in the spacious yard, a parade of locomotives, including the preserved Ivatt Atlantic No. 251, had been arranged. To this parade, No. 62822 added herself, to the delight of everyone present; and there she remained until the visitors, a little sadly and very reluctantly, had to depart homewards.

An Interesting Old Photograph

● MR. JOHN M. BALL, of Cheadle, has sent us the interesting old photograph reproduced on this page. It depicts an example of a type of steam tractor which has long been defunct, being a three-wheeler on which only a single leading wheel was used for steering. The name, *Progress*, is clearly discernible on the side plate below the smokebox, and the oval plate on the motion casing reads: "Cheadle Carrying Company Limited." Mr. Ball states that the photograph was taken 70-75 years ago, and adds: "My mother, who is in her 83rd year, can well remember taking the engine-driver's 'snapping' to him, when she was a schoolgirl. The engine was used chiefly for carting coal in the Cheadle, Staffs, coalfields. What adds further interest to this photograph is the fact that the flagman, seen on the left, celebrated his 100th birthday last August, a peal of bells being rung from Cheadle parish church to mark the occasion."

No maker's plate is visible in the photograph, so we are unable, at the moment of writing, to say who built the engine or when.



New Club's Success

● WE WERE pleased to receive from Mr. R. Griffiths, hon. secretary of the Blackheath (Staffs) Model Engineering Society, a letter giving details of his society's success at the recent handicrafts exhibition organised by the Stourbridge Rotary Club. Mr. J. H. Westwood's 5-in. gauge "Halton" tank locomotive won first prize; Mr. L. Griffith's gauge "1" *Dot* won second prize, while a model lathe by Mr. J. Higgs and a model cross-channel steamer by Mr. T. W. Parkes were both certified as Highly Commended.

We can well imagine the pleasure and pride which the Blackheath society, which is not yet a year old, feels over this success; we offer our sincere congratulations and we hope that the society will be able to record, in due course, many more such successes. As time goes on, the winning of prizes at model engineering exhibitions becomes ever more difficult, because the quality of workmanship is always improving; consequently, the judges have to be increasingly exacting in their judgments. This is essential to the development of model engineering and the safeguarding of good craftsmanship.

A Pair of Ploughing Engines

● MR. W. E. ATKINSON, of Hadfield, near Manchester, writes :—"Readers may be interested to know that I came across two Fowler ploughing engines while travelling down Watling Street, near Rugby.

"They were stopped by the side of the road, and the drivers allowed me to have a look round. The engines were numbered 15222 and 15223.

"They are the property of Messrs. J. B. Carr Ltd., public works contractors, of Tettenhall, Staffs, and are being used by this firm for dredging inland waterways, the dredging bucket being operated by cables in much the same way as a plough would be.

"I understand from one of the drivers that Messrs. J. B. Carr Ltd. have eight of these machines and no doubt any reader interested would be allowed to inspect them. It is pleasant to think these grand old engines are still doing very useful work."

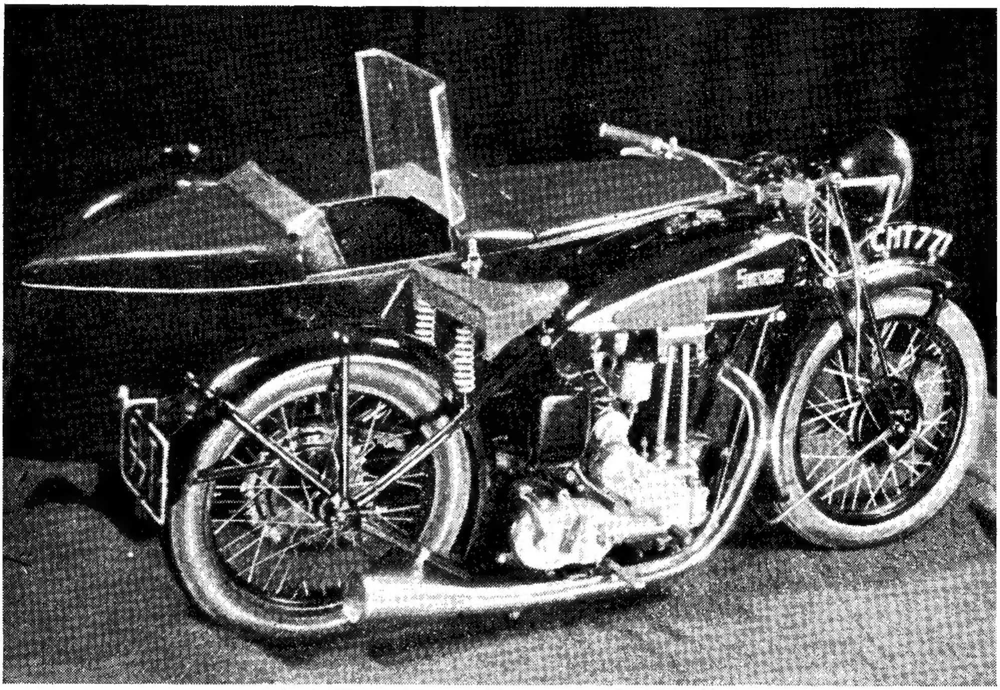
A Quarter Scale Motor-Cycle Combination

by G. F. Wills

(Photos by Ronald Rietti Ltd., Chingford)

THE idea of making a scale model motor-cycle was first conceived in the winter of 1946, when, thinking over what new model should be started, I decided it must be an i.c. one, owing to the predominance of locomotives in our club and my preference for petrol engines. Next, what form should the model take? Well, having surveyed the field of i.c. models, a working scale motor-cycle seemed a new departure and what could be more convenient than to model my own machine, which, incidentally, is not on the market now?

The prototype was one of a range of motor-cycles made by the Stevens Bros., Wolverhampton (of A.J.S. fame), in 1935. It is of 495 c.c. capacity, $3\frac{1}{8}$ in. bore × 4 in. stroke approximately, so 3 in. to 1 ft. seemed a suitable scale for the model. Working on this, a full-size drawing was made for the model engine; incidentally, this was the only real drawing made for the whole job. From this it was seen that the scale was convenient and workable, and a start was made on the crankcase patterns, which, being a second-rate woodworker, I decided to fabricate in brass. This was successful and the resultant castings were nice and clean.



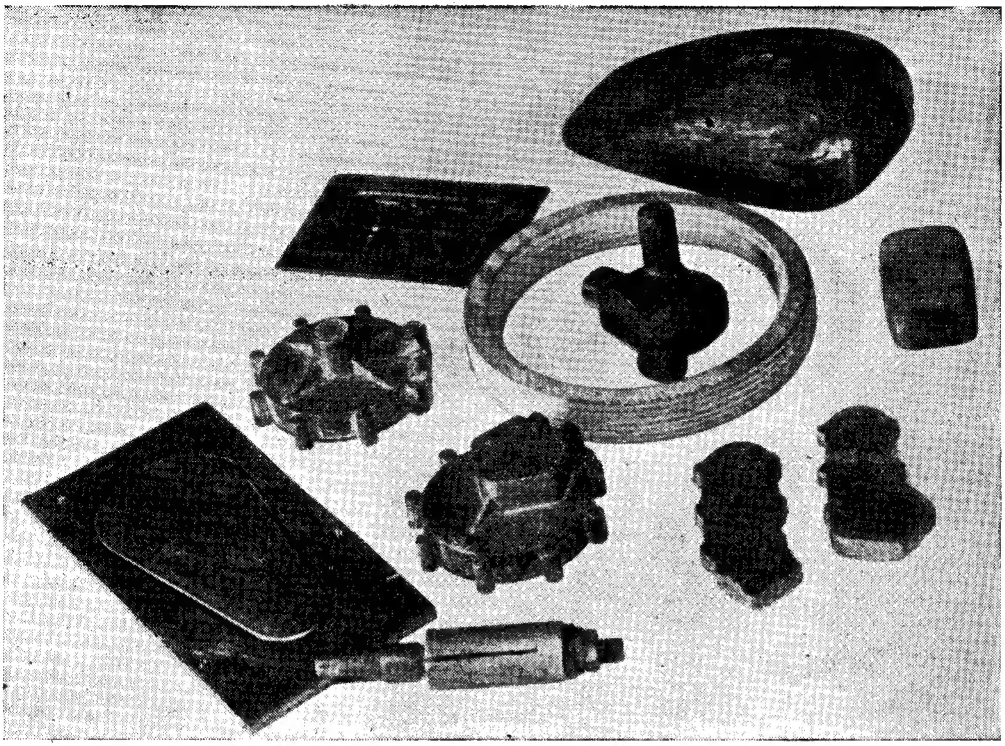
Mr. Wills's quarter-scale motor-cycle and sidecar

Departures from correct quarter scale were few, and these only where necessary in the interests of a successful working model. For instance, the crankshaft and internal flywheels were fabricated and brazed to make a rigid assembly and not built up and nutted, as in motor-cycle practice; this necessitated using a split big-end, the connecting-rod being machined from solid phosphor-bronze.

Phosphor-bronze main bearings were fitted, too. The cylinder was turned from solid meehanite and lapped with a split aluminium lap to suit the hardened steel piston.

A rough pattern was made for the cylinder-head and cast in iron, leaving a machining spigot protruding from the top. From this the inside was turned and the fins cut on a friend's milling machine, as these go only part of the way round. The head then had to be drilled and the valve seats cut to take the stainless-steel poppet-valves, which have valve springs of ordinary spring wire, retained by caps and "C" washers fitting in grooves in the valve stems.

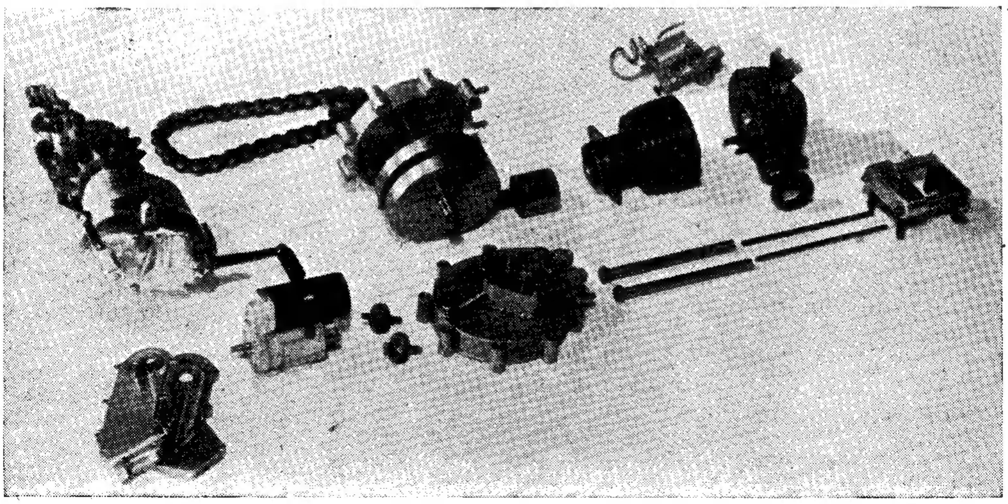
The exhaust port was screwed $\frac{5}{8}$ in. × 26 t.p.i. By the way, standard taps and dies were used for all threads on the model, as my lathe, which I



Some of the patterns and formers used in construction

bought cheap during the war, is of ancient vintage and doubtful parentage, and although it performs well as a plain lathe, the leadscrew has " had it."

Thinking to avoid gear cutting, I used standard ¼-in. pinion wire for the half-time pinion, but found out that I could not get a larger size to give me a 2 to 1 reduction, so had to get a pair of gears cut to suit. These were pinned to the camshafts and the whole case-hardened. The



The component parts of the engine

cams, having a lift of $\frac{1}{16}$ in., were not cut in the approved manner, as they were so small, but just filed by eye, using the full-size job as a pattern.

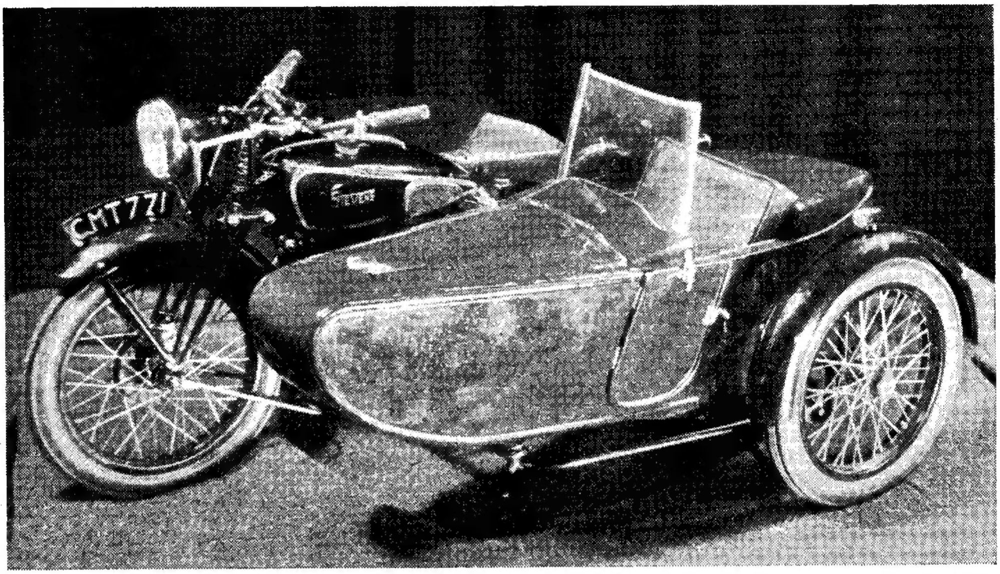
Quite a lot of thought was given to the ignition problem ; how to get a quart into a pint pot. Having looked at a number of miniature magnetos, I decided that to make a " magdyno " in quarter scale was impossible, at least for me, so, therefore, I must resort to coil ignition but conceal it somehow.

From the inlet camshaft, a chain of five gears, made from pinion wire, drives a contact-breaker in the dummy " magdyno " ; this has a full-size pair of points and occupies the whole space inside. The coil and condenser are situated in one half of the petrol tank and a Nife ignition battery in the side-car boot.

As the model is not intended for racing or long periods of running, the scale oil pump is a dummy, lubrication is by petroil with a shot of oil in the sump before running.

A scale outside Amal carburettor was made, but has an adjustable needle-valve for mixture as in ordinary model practice, and a plunger throttle. Not having made a four-stroke before, I found this engine far easier to start and the mixture control not so touchy as with two-strokes. Of course, the engine has not a high compression ratio, but this was purposely done so as not to make it too temperamental.

From the engine the power is transmitted to the gearbox *via* 8 mm. Renolds chain, which was the smallest I could obtain and is overscale. The sprockets were all made by making a jig having three holes, one for the centre and two more at the correct pitch centres and diameter according to the number of teeth required. They were then plated on the blank with a pin through the centre. The pitch holes can then be drilled, holding the jig steady with a pin whilst the next hole is being drilled. Having drilled the pitch holes, the blank is mounted in the lathe and turned to the correct o.d. This breaks into the pitch holes and all that is left to do is to run round with a file and point the teeth.



The sidecar side of the combination

I have made several full-size sprockets this way for motor-cycles and they have been satisfactory, but the jig holes must be marked out very accurately.

The gearbox is a scale Burman but with only two speeds and a foot change, the kick start being dummy, as the working scale one first made was not strong enough to stand up to its job. The clutch follows full-size practice—has four steel plates and two Ferrodo rings.

The framework is made from brass tubing and silver-soldered throughout with steering-head running on $\frac{1}{16}$ in. dia. balls and fitted with steering damper, the forks being sprung and damped as in the prototype.

The time had now come to think about wheels —and first, tyres. Not being able to obtain any proper ones in that scale, I was lucky enough to buy some seamless pram tyres the right size. Rims were cast in aluminium and turned to shape, hubs and brake drums fabricated in mild-steel. Spokes were made from 0.036 in. stainless-steel wire which dies nicely 15 B.A. whilst the nipples were $\frac{1}{16}$ in. dia. countersunk brass rivets drilled and tapped 15 B.A. then slotted across the head with a junior saw. In building and truing up these wheels I was faced with the same problems as in full-size, another instance when one can gain experience

(*Continued on page* 906)

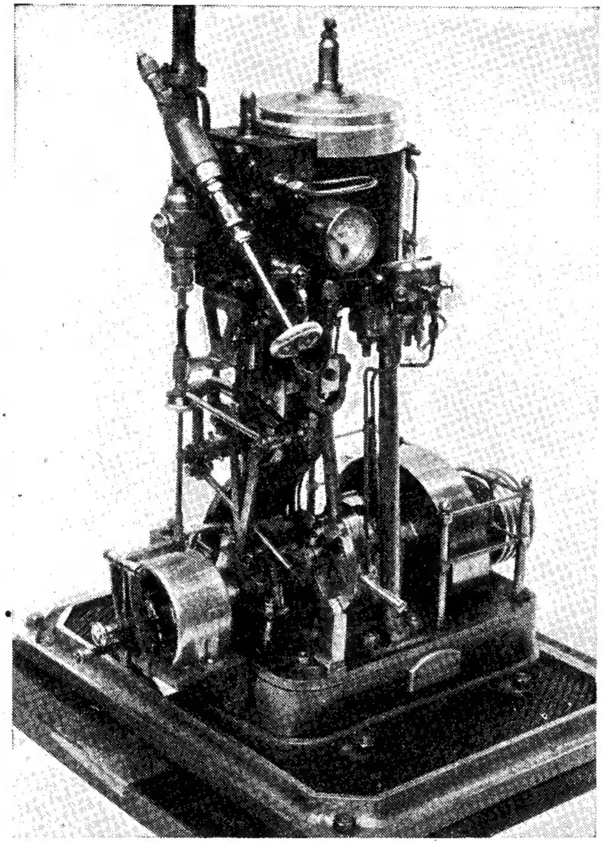
A SINGLE-CYLINDER VERTICAL STEAM ENGINE

by STEPHEN H. CLARKE

THE Editor has asked me to say something about the single-cylinder vertical engine which was awarded a bronze medal and the Ferguson Prize at the recent "M.E." Exhibition, and if such will help others to make something of the kind, I am only too pleased to do what I can.

Fifty years ago I was as mad as anybody over petrol engines, but now I must say I still love the sweetness of running of the steam engine and especially the older type where one can see the co-ordination of all the parts working.

I did not make this engine with any intention of competition, but sent it to the London exhibition to be in company with the lovely "Stirling" of Dr. Hebblethwaite and the trim twin horizontal engines by Mr. Ayres, both very valued friends of mine.



A view of engine, showing drip feed oilbox

The making started this way. I saw in the window of a model shop a vertical engine which pleased me and which I thought would clean up into a nice model, so I bought it. However, when I came to "do it up" I found so much that was not to my liking that I decided to rebuild it entirely and, in fact, the only parts used were the cylinder body, which had to be rebored, properly studded and the ports, which were cast in, recut. The bed which was built up with rough plate was machined all over and the standard, also of plate, was refaced on all surfaces; apart from these, everything was new.

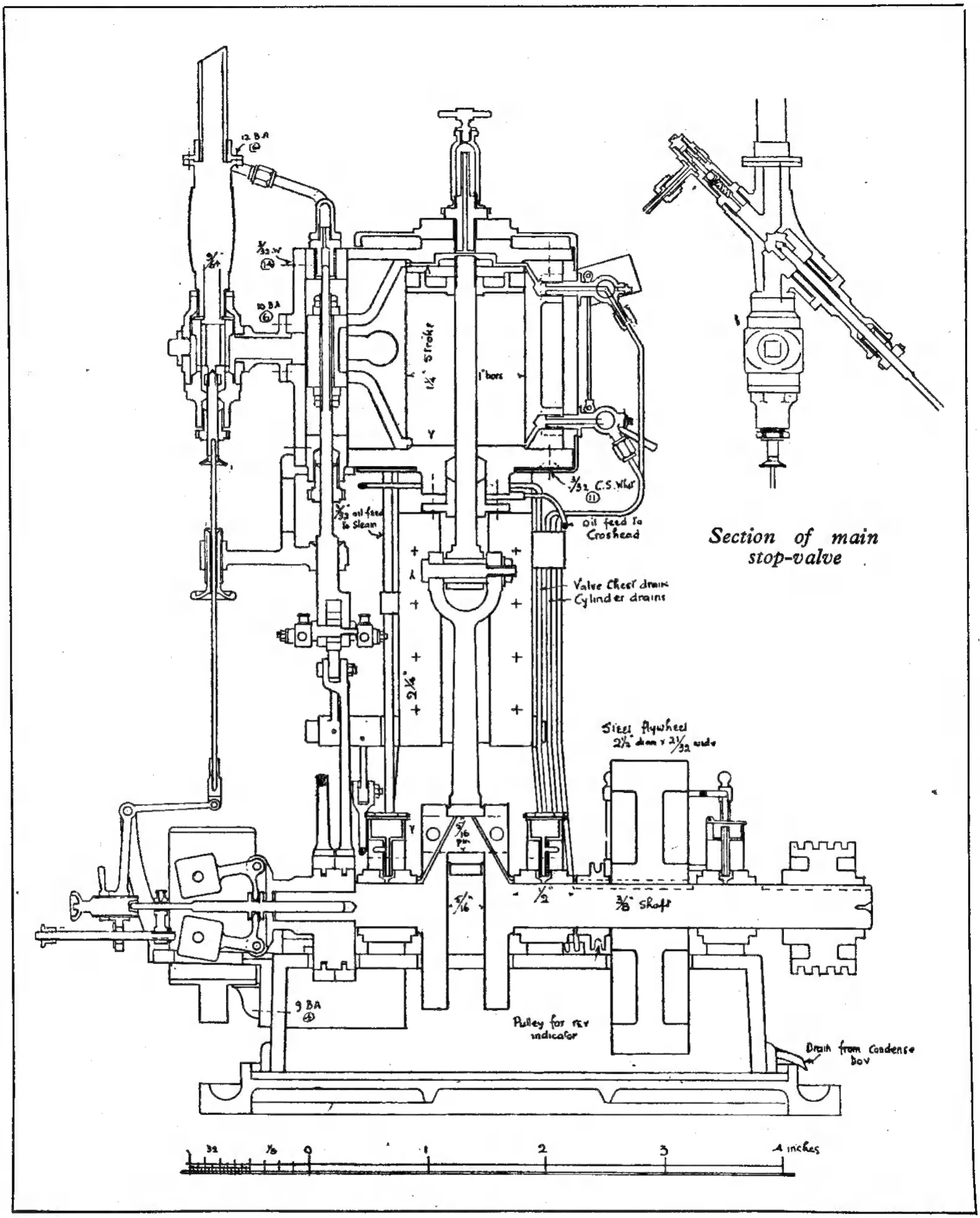
I think a reversing engine with governors is not at all usual but I wanted to see all the parts working even though under "Board of Trade Regulations" the governor spinner had to be partly cased.

As an engine of this description would be likely to run for long periods, lubrication required very careful attention and I decided to fit adjustable drip feeds to the two inner main bearings, the crosshead slipper and connecting-rod bearing and to fit a pump for cylinder lubrication which would also lubricate the piston on governor valve as it passed, emulsified, to the cylinder. The outer bearing, which could be "got at" without danger, has wick feed from the oil box.

After cleaning up the cylinder bore it was lapped with a small India stone, spring-set in a wood mandrel, a good fit in the bore, well oiled and put in the lathe and left running for a morning and an afternoon.

I originally fitted piston rings but later fitted soft asbestos and white-metal packings. I think this is more satisfactory on small bores. The covers were made out of old bits of cast-iron, the oval gland being done on the Holtzapffel lathe. It would probably have been as quick to file them but it is fun to watch the queer evolutions of the ellipse chuck, which, of course, makes a very perfect oval.

A displacement lubricator is fitted to the top cover which is sufficient to start and until the pump has got its supply through, and there is a small lubricator to the steam chest for the same purpose.



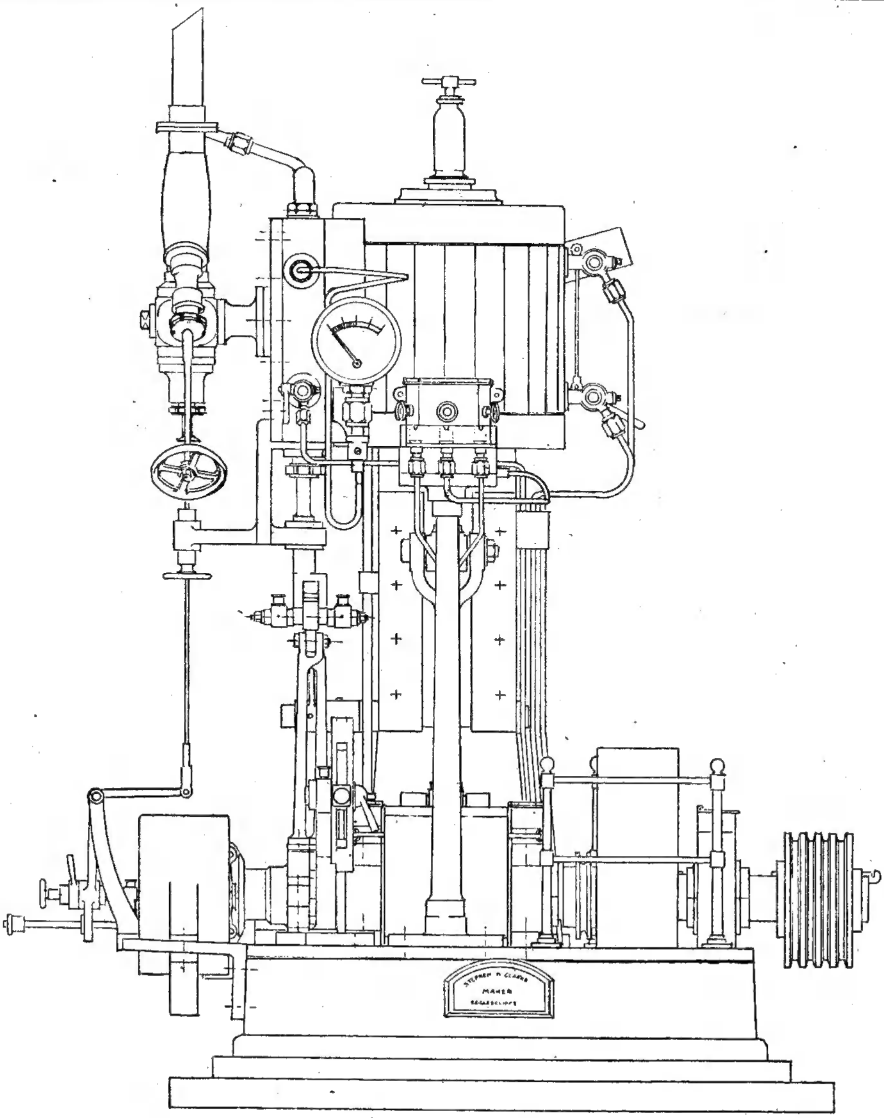
Section of main stop-valve

There is a small reservoir on the top of the crosshead at the back of the piston rod and this is filled with wadding, prevented from flying out by a screwed cap pierced in the centre. Fixed at the top of the standard is another small oil box fed from the main drip feed box and this has a tiny dipper which is free to lift and which just touches the wadding at the extreme top of the stroke.

From the oil box are two outlets at the bottom, one to the bronze slipper face grooved oilways and the other to the gudgeon-pin bearing on top of the connecting-rod.

The crankpin is lubricated from oilways drilled through to the face of the web and these scrape oil from the face of the main bearing bushes which is thrown, by centrifugal force, to the crankpin outlet.

The cylinder oil pump is of the oscillating type,



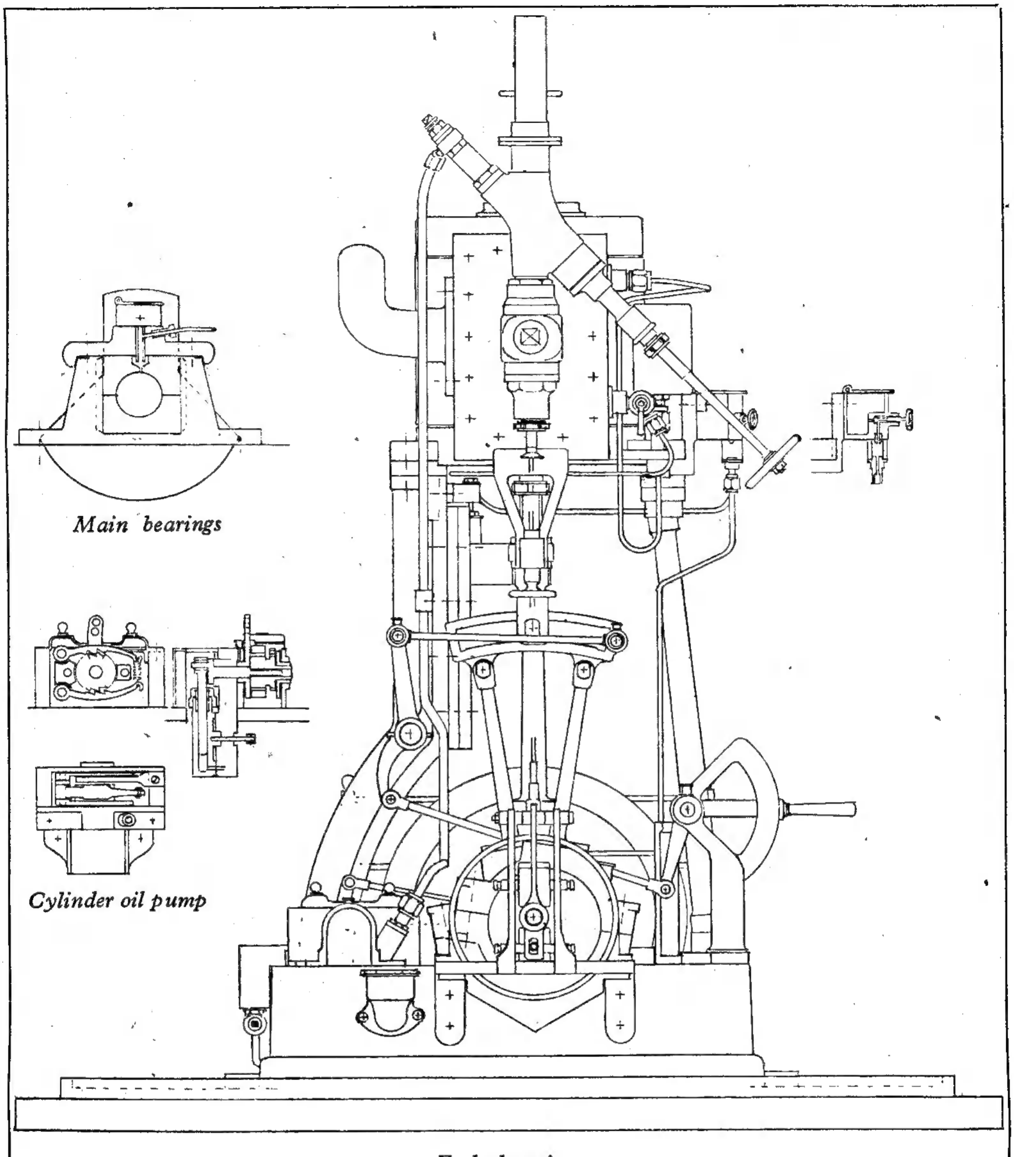
Front elevation

part submerged in the oil tank fitted under the bedplate, and is driven by a wrist pin in the side of the reverse eccentric strap.

As the speed is high, it would need to be of robust construction, the usual fine-toothed ratchet seemed unsuitable and as the speed reduction was to be 30 to 1, wide tooth spacing would need a large wheel; so I made the ratchet wheel $\frac{5}{16}$ in. dia. with 15 teeth $\frac{1}{8}$ in. wide and this gave a pitch of 0.0654 in. and a corresponding good depth. Two spring-loaded horizontal ratchet levers, one at the top and one at the bottom, which, with the odd number of teeth, engaged alternately, so giving the same motion as a 30-tooth ratchet with a single pawl. The check spring has teeth half the pitch of the main ratchet and so only one was needed.

The pump cylinder is 5/64 in. bore and I found it almost impossible to pack the usual type of gland this size, so the gland cap is screwed to the external thread on the cylinder and the clear gland space packed with fine shredded asbestos and fine white-metal filings made into a thick paste with oil, a loose sleeve pressing it down tightly.

Check valves are fitted on delivery at the pump



Main bearings

Cylinder oil pump

End elevation

and also at the delivery point in the steam pipe.

The crankshaft is built up with silver-steel shaft and crankpin and mild-steel webs pressed on and with fitted silver-steel dowels.

The flywheel is steel and a pulley is fitted for drive to the revolution indicator, but this has not yet been made.

The two eccentric sheaves, extension sleeve and governor spider bracket are all in one piece and fixed to the main shaft with 6-B.A. Allen screws.

The governor gear is on the lines of the Brotherhood engines, but with a piston valve instead of a double-beat valve. The angle throttle gives an almost straight through flow of steam.

The governor weights, arms and pivot spindles, are all out of the solid. Great care is necessary to be certain that the weight of each exactly balances to prevent vibration.

The drain pipes from the cylinder and valve chest lead into a condense box which discharges into the gutter at the base.

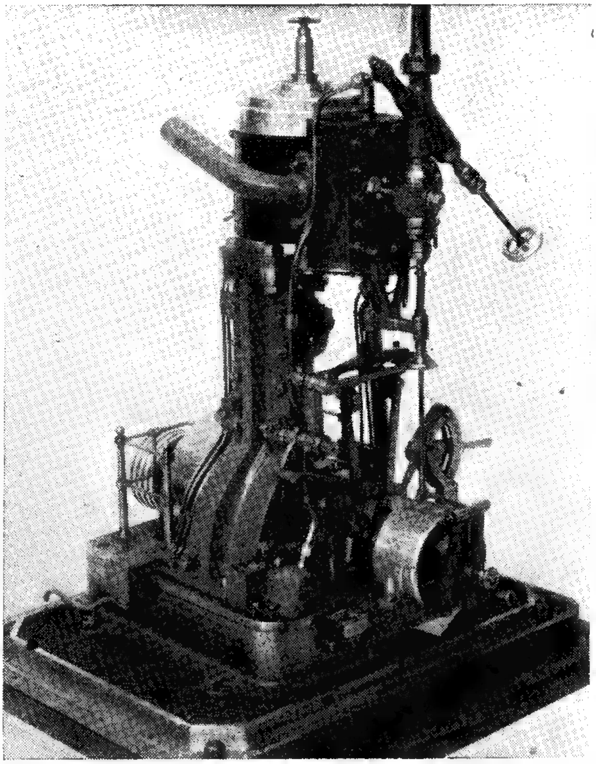
The reversing lever is locked with a side screw instead of slotting the quadrant, so no springs are required and, as reversing would not be frequent,

it obviates chatter of motion at high speeds.

The main standard is built up with plate and angles at the top and [redacted] square section rib at back.

There is [redacted] good deal of pipework and I have tried to keep these in as straight lines, from point to point, as possible. Nothing, to my mind, will spoil [redacted] otherwise clean-looking model more than straggly pipes which do not seem to be certain where they are going.

The oil and condense pipes are 0.056 in. o.d. dia., 0.026 in. bore and the cylinder oil feed 3/32 in. o.d. The smallest pipe I use is 0.0225 in. o.d. × 0.005 in. bore and slips easily into the



0.056 in. o.d. pipe. There is [redacted] on this engine.

The union cones [redacted] turned after sweating on to the pipe and slip easily into $\frac{1}{8}$ in. screwed union nuts. The pipes [redacted] turned down for fitting into union tail pieces so that the outside of these [redacted] flush with the entering pipe.

The engine itself is a fairly straightforward job; the fittings, oil pump, etc., are rather like watchmaking, but I am fortunate enough to have [redacted] Wolf-Jahn and [redacted] Whitcome Webster on which to do the very fine work. I think [redacted] of the most comic jobs I did was to reduce the size of some 16-B.A. nuts to $\frac{3}{4}$ in. scale $\frac{3}{8}$ in.

A Quarter Scale Motor-Cycle Combination

(*Continued from page* 901)

from model engineering, e.g. I found that the spokes in three wheels on my combination were laced in [redacted] different manner, and also that most motor-cycle wheels have 40 spokes. Miniature ball-races out of aircraft surplus apparatus provided the hub bearings and working brakes completed the job.

Items such as the petrol tank, mudguards, headlamp, etc., were beaten up on oak formers out of 1/32-in. brass sheet; where there was too much surplus metal to beat out, vees were cut and then silver-soldered, the whole filed and papered smooth.

At this point, the method of making the number plates may be of interest. First, the index number was filed out in [redacted] piece of 1/32-in. mild-steel like [redacted] stencil. This was soldered to a backing plate of $\frac{1}{8}$-in. mild-steel, then [redacted] piece of thin aluminium was placed over the numbers, on top of this [redacted] piece of hard rubber sheet about $\frac{3}{16}$ in. thick, and the whole lot squeezed in the vice. The rubber forces the aluminium into the numbers, leaving them embossed on the surface.

The sidecar is constructed and fitted [redacted] in the prototype, using thin plywood, mahogany framework and upholstered in sponge rubber covered with rexine. An 800 cycle battery situated forward in the sidecar supplies current for the lights, to avoid drain on the ignition battery.

Not wishing to spoil the ship for a ha'porth of tar, only the sidecar was painted by hand, the cycle parts being professionally stove enamelled and chrome plated.

Having only just completed the model at the time of writing, I have not been able to get much data [redacted] road performance, but by engaging [redacted] gear and gently releasing the clutch, she pulls away nicely, [redacted] later, perhaps on [redacted] suitable floor space, I will be able to lock the steering damper and let her do [redacted] few laps; the gear ratio in top is the [redacted] as the prototype, so the speed will be quarter scale.

Another photograph, showing the comparative size of the model with a lady admirer, is reproduced [redacted] the front [redacted] of this issue.

FURTHER TURNING POINTS

Being the Idle Thoughts of [redacted] Not-so-Idle Fellow

by "Scotia"

SINCE my last article appeared in the January 12th issue of THE MODEL ENGINEER dealing with hand-turning tools for use on soft metals, it has become evident that some further comment on this apparently unusual subject is called for.

others besides, arises mainly from my long association with them, during which time I have acquired an ability to handle them with [redacted] certain measure of dexterity, and to obtain from their use some satisfaction in the work they accomplish.

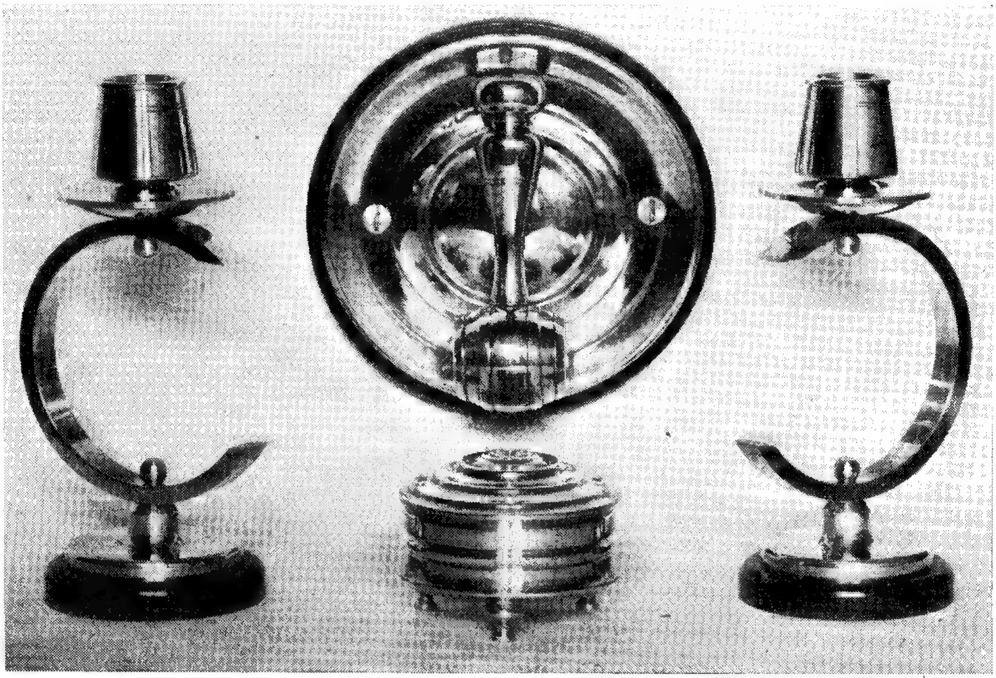


Photo by] [*Wm. Bell*
Some pieces of original design by the author—the striker of the knocker is a facsimile of a little barrel

The skeleton set of hand-tools I described were meant for the benefit of those who perhaps knew little of such tools, and it [redacted] not intended that the amateur, trying [redacted] bit of hand-turning for the first time, should even employ all the tools mentioned. If he [redacted] manage to use the parting tool in the lathe saddle for instance, then he should do so, [redacted] it is no wish of mine to make hand-turning as difficult [redacted] possible for the novice.

To give another example, it is possible to turn [redacted] tapered or conical piece of work by simultaneously hand-operating the longitudinal carriage feed, and the transverse cross-slide feed, but it follows that the surface produced [redacted] be neither smooth nor accurate. With such [redacted] base to work on, however, [redacted] excellent result can be achieved by the careful use of hand-tools. My use of the range of tools mentioned, and several

It has been said that every lathe has a soul. Whether this is the case or not, it is difficult to say. There is one element of truth, however, which lends colour to its possibility, and that is the necessity to know your lathe thoroughly in order to obtain the absolute best out of it. Human nature being what it is, this usually entails a period of trial and error, and it is an indisputable fact that we all learn something from the errors we commit, the character of which being many and varied, inasmuch [redacted] we should be aware of what will happen, should the [redacted] procedure be carried out.

Paradoxically, then, [redacted] man profits by his own mistakes.

By taking careful note of the performance of the lathe in the various stages of the work, it should be possible to [redacted] just what it is capable

of doing, and by careful " nursing," in one form or another, see the job through to [redacted] successful conclusion.

In completing brass work of [redacted] ornamental nature which may have [redacted] hollow interior much similar in profile to its exterior, we [redacted] confronted with the ever-present possibility of chatter which invariably occurs, [redacted] least in the finishing stages. A notable example of this occurs in the latter stages of turning [redacted] hand-bell, and if the reader will bear with [redacted] little longer, perhaps it may interest him to know how some, at least, of this trouble [redacted] be overcome. Every[redacted] is familiar with the fact that when a gong (or bell) is struck, a series of tonal vibrations arises, which will at once cease, should [redacted] hand be placed upon it.

This phenomenon, commonplace [redacted] it is, can be duplicated in the lathe, by gently allowing two fingers of the left hand to press lightly, with varying intensity, on the under-side of the work, while the hand-tools are being applied, the neutralising effect obtained greatly facilitating the fine finish desired.

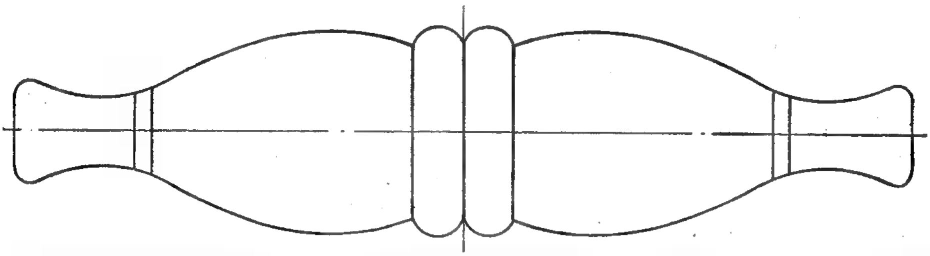
This is particularly suitable while finishing off, and touching up, during which period the hand-

should not be ground too thin, [redacted] it is possible for an oscillation to occur in the tool itself, which is at once transmitted to the work, to the latter's detriment.

On the other hand, it is not advisable to have the tool too thick, [redacted] one is apt to lose adaptability of it, the over-thickness tending to defeat its manoeuvrability ; indeed, [redacted] over-thick forming tool in one's hand, appears to assume the properties of [redacted] piece of wood. In my experience, about $\frac{1}{16}$ in. thick [redacted] the cutting edge is the ideal to be aimed at in all forming tools. Just [redacted] point concerning hand-tools—they should be kept in a keen condition and always oil-stoned before using.

There is infinitely more danger attached to working with dull-edged tools than is generally realised. If one is foolhardy enough to [redacted] blunt hand-tools, the operation might be described [redacted] " Destination Unknown," as the dull edge of the tool, in resisting the mounting pressure put on it to do its duty, invariably has [redacted] preference for flying into the whirling jaws of the chuck, much to the discomfiture and possible injury of the operator.

Concerning the question of design, I often



Sketch, showing beneficial effect of members on plain surfaces, and their disposition on balanced work

tool is usually presented tangentially to the work-piece.

Very often this [redacted] be quite an uncomfortable procedure, as [redacted] goodly heat is generated by the action of the hand-tools, which is at once passed [redacted] to the fingers, via the work. Somehow a rag held by the fingers just doesn't give the desired result, although it is essential that the work itself be packed tightly with rags or waste, [redacted] this helps immeasurably in overcoming chatter and oscillation, and indeed, in many pieces of work of [redacted] less ambitious character, is all that is required.

I hasten to add that the foregoing comments [redacted] given purely for the interest attached, and should anyone care to try it out, great care must be taken to guard against possible accident.

There must be absolutely [redacted] roughness on the work, [redacted] this would at once [redacted] the fingers to be cut. Due care must also be exercised to see that during the period, [redacted] rough edges [redacted] created on the diameter, [redacted] these would again be passed on to the fingers.

Perhaps it may be of interest to record that [redacted] the many occasions I have carried this out, I have never yet sustained [redacted] cut finger.

Regarding the hand-tools themselves, they

find that one based [redacted] simple lines is in the end most effective, and very pleasing to the eye. May I say at this stage, that I would like very much to have given some expression on design by my friend, Mr. F. Pain of High Wycombe. This gentleman, an expert wood-turner, and almost [redacted] authority on design, demonstrated his skill on the lathe at the last " M.E." Exhibition, and it was only his indisposition which prevented some of his valuable comments concerning design from appearing in this article.

To continue : the appearance of near-finished work can be further enhanced by the addition of " members," which is rather [redacted] old-fashioned [redacted] given to light grooves cut [redacted] the diameter by the application of the corner of the flat-tool to the work. These can be put [redacted] single, double, triple or even quadruple, with close attention paid to equal spacing, and in the case of balanced work, to correct positioning. Although the addition of members, undoubtedly lends distinction to the work, it should be borne in mind that [redacted] profusion of these tends to over-dress, and in consequence they should be given in small doses. It is a wise plan to draw rough sketches—full size if possible, of the proposed piece of work before starting, as [redacted] has then the

advantage of visualising the finished article. Indeed, several sketches might be made, one of which can finally be chosen. In this way, time and material can be saved.

In considering the question of smoothing and polishing the work, one of several methods might be employed. It is possible to finish the polishing entirely by the use of a polishing dolly, with the lathe at top speed. It is also possible to finish the work, while it is still in the lathe, by the use of polishing agents. I favour the latter method. It will be understood, however, that all lines and scratches must be removed as far as possible before applying the polish.

This can be achieved by the careful use of varying grades of carborundum, or emery cloth, the most well-worn of which is applied prior to the use of the polish.

For some time now, I have used Messrs. Cannings' "Green Chrome Gloss" with good results in this connection. A superb finish can be achieved if the work is really hot, when the polish, which is really a block paste, is applied, and this can easily be accomplished by friction, e.g., pressing a piece of old emery cloth to the work, to create a heat. When the surface is entirely covered with the green film, a clean cloth is then used to remove it, with a gentle, but firm movement, to reveal a surface finish

(*Continued on page* 911)

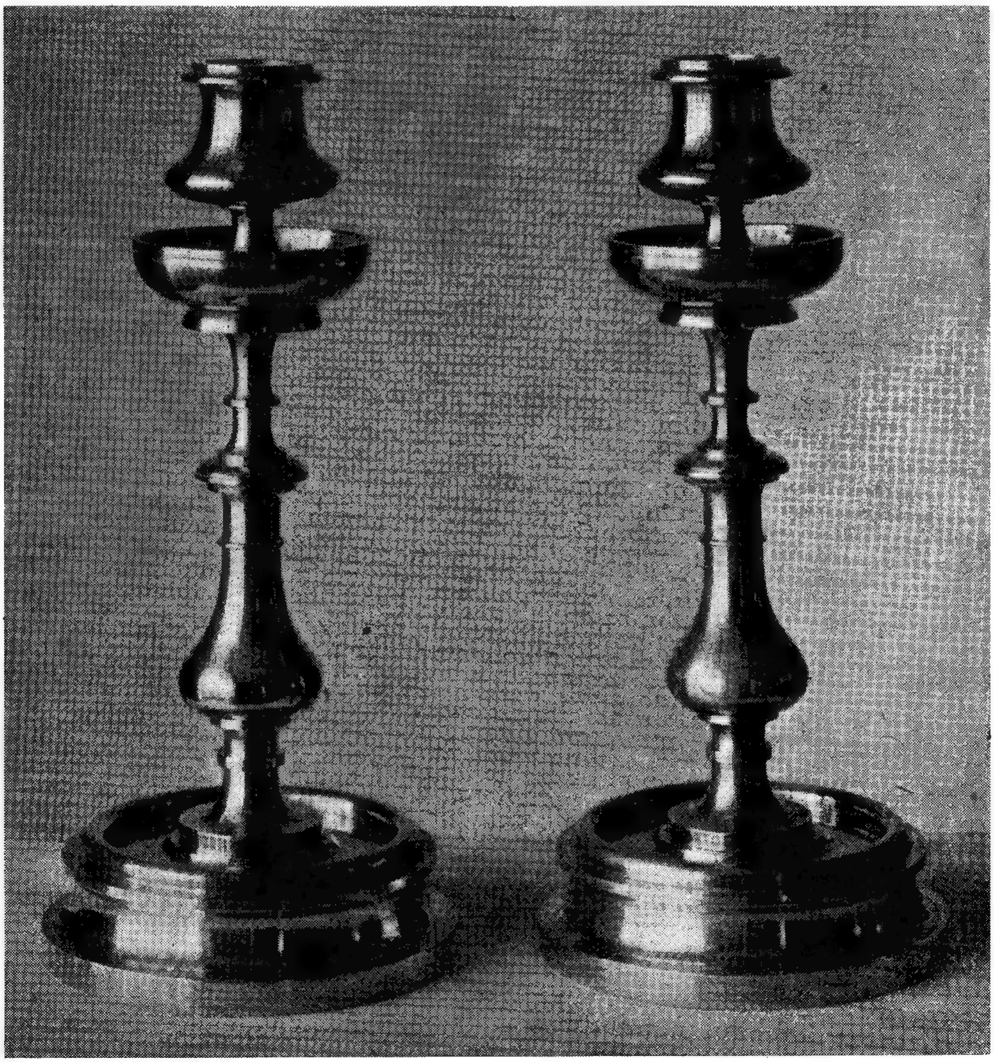


Photo by] [*Ronald Goodearl*

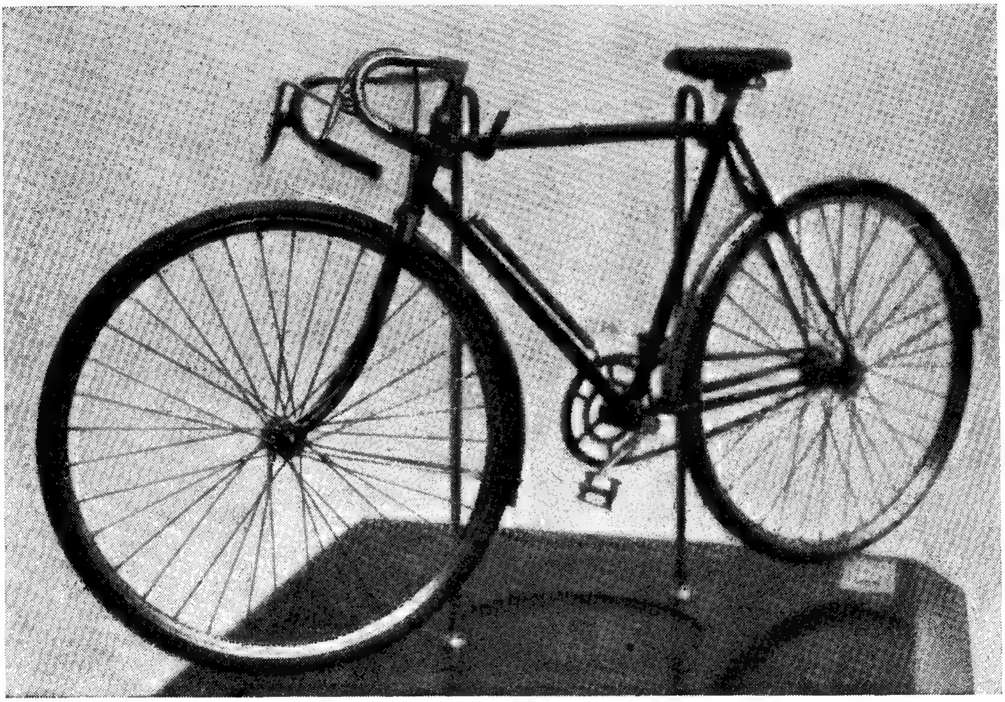
These beautiful examples by Mr. F. Pain, of High Wycombe, clearly show an excellence of workmanship seldom equalled

A Scale Model Rudge Bicycle

by G. C. Seymour

IN response to what I considered [redacted] very flattering request from the technical editor of THE MODEL ENGINEER for [redacted] description of the model cycle (with which I was no end bucked to have hooked [redacted] "gong" at the "M.E." Exhibition), and having now got over my stage fright, I will get down to it.

strip such as used to tie up crates. The rollers were drilled and parted from $\frac{1}{16}$-in. silver-steel by means of [redacted] special form of tool, Fig. 2; the rivets were parted with [redacted] similar tool and [redacted] 0.032 in. dia. Three punches were used in sequence in a little fixture for riveting up, as in Fig. 3. So far, so good.



The germ of the idea was [redacted] chance remark that [redacted] bike would look a little silly, as a model. Anyway, I decided to find out for sure.

The first thing that came to mind was that some tools would be a great help, so [redacted] pair of rolls were turned to form the rims. This proved a surprisingly simple job. One roll was screwed flat against the faceplate, which acted [redacted] excellent guide for the blank, keeping it from wobbling through the rolls. The blank was formed from 22-s.w.g. cold-rolled close-annealed steel sheet, first [redacted] ordinary washer, which, with the aid of a hammer and [redacted] few heartfelt expletives, [redacted] turned inside out to form [redacted] thin slice of cylinder. Fig. 1 shows how this was done.

The next item was the chain which, as it has 220 link plates, meant [redacted] "follow-on" press tool. This was made, and eventually put to work; the links were stamped out from bright steel

By now I was warming up (spark well advanced), so I started on the frame tubes, which were machined from $\frac{3}{16}$-in. cold-rolled steel. The drilling, with [redacted] ordinary twist drill, was done from both ends. The method employed is old, but interesting, in that accuracy is possible, even on [redacted] "boss-eyed" lathe, provided that the drill point and tailstock centre, when fully extended, meet the same spot in space. Having centred and drilled $\frac{1}{4}$ in. deep both ends, the drill is transferred to a chuck on the mandrel, standing out [redacted] little over half the length of the work-piece. Cross drill [redacted] short piece of rod and sweat about half-way up the work-piece to form a handle, but please file off the burrs, or you will [redacted] run out of Esperanto and skin as well, if the drill takes charge. Run fairly fast, and feed steadily, with plenty of suds. Slowly rotate the work *all the time* the drill is cutting. When the tubes were drilled they were turned over the

outside on [redacted] good-fitting rod in the tailstock chuck.

Brazing up was [redacted] —— (deleted by censor) job and had to be done on pillars standing up from [redacted] steel plate, with little dumps of firebrick fragments around each set of joints.

All the cones and cups for the bearings had to be made from Toledo non-shrink steel, [redacted] the first set twisted all ways in hardening.

The free-wheel is a simple ball wedge-type with eight 1/32-in. balls.

The chain wheel, being in two parts and very flimsy, the teeth were milled first on a reasonable blank and the rest of it done in wheel chucks.

The brake cable casing was wound from 0.015 in. phosphor-bronze wire, and was done without any special fitments. The method may interest somebody, so here it is! Cut a short piece of rod which will give the required o.d., hold in draw-bar collet, bend end of wire at right angle and poke into one of the collet slits. Run the lathe in back gear, and wind enough to enable your finger and thumb to pinch the arbor and wire as it rotates. Leave off tensioning the oncoming wire, and proceed as far as the arbor will allow. Change collet for one to suit o.d. of spring and now use [redacted] much longer arbor and grip both. Now go right ahead for as long as you want, sliding the finished spring into the hollow drawbar each time you fill the arbor up.

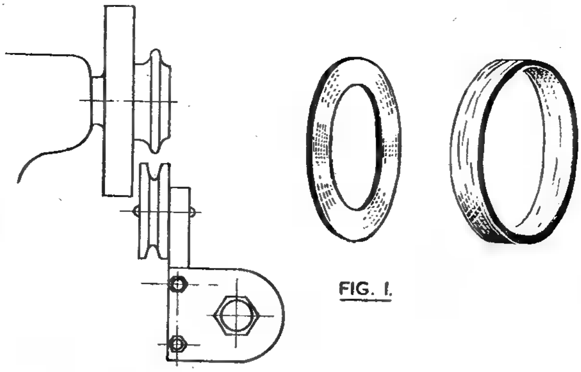


FIG. 1.

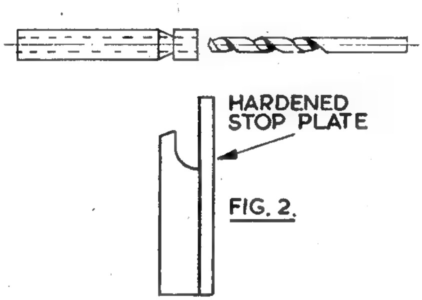


FIG. 2.

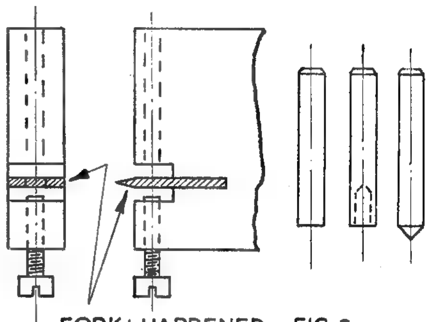


FIG. 3.

FURTHER TURNING POINTS

(*Continued from page* 909)

which has to be seen to be fully appreciated. Perhaps, for the interest attached, it would be worth mentioning, that in an old book on model work, which I possess, [redacted] statement is made to the effect that weak beer is [redacted] very good polishing medium for brass. I have never got around to trying this out, but should anyone care to do so, I feel sure that the present-day strength of beer will be just about right, and will require no watering down!

There are many circumstances often existing to defeat the ultimate aim of good work, and these take many forms. The state of the lathe itself, however, should call for close attention before commencing work of this kind. A bit of backlash in the saddle, [redacted] "lift" in the spindle—small misalignments of the lathe parts—all these features combine to add their quota in making difficulties.

It sometimes happens that difficulties arise with [redacted] small lathe in fairly good shape, which would normally not occur on a large size lathe, even taking into account the fact that the latter might be in a deplorable condition. By virtue of its weight alone, [redacted] full-size lathe very often gives little trouble in producing good work.

All of which goes to substantiate, if somewhat conversely, [redacted] L.B.S.C.'s" well-known dictum: "You can't scale Nature"—even in machine tools.

IN THE WORKSHOP

by "Duplex"

No. 78—Making a Knurling Tool

AT this year's "Model Engineer" Exhibition, great interest was shown in the knurling tools displayed and many requests were received for a full description of their construction.

The knurling tools in question were made several years ago, following an article on the subject that appeared in THE MODEL ENGINEER; but, to suit personal preferences, the published design was modified in many particulars.

In commercial practice, as exemplified by the automatic machine producing small parts in large quantities, the knurling wheels may be put into cut by being forced directly against the work, and the machine is then designed to withstand the stresses thus set up.

The light lathe, on the other hand, may be less robustly constructed, and as a consequence, the mandrel bearings will probably suffer unnecessary wear if subjected to the heavy side thrust imposed when an ordinary forked knurling tool is fed directly into the work. Therefore, to eliminate this side thrust, a tool of the form illustrated in Figs. 1 and 2 is used instead of a plain knurling wheel holder. It should be borne in mind, however, that a knurling wheel has but a limited cutting capacity, and the impression formed on the work is largely the result of compression forcing the knurl into the material. The tools illustrated, however, are designed to allow the two knurling wheels carried in the head to be pressed into the work by screw pressure, and, as the two forked arms are free to swing, the pressure exerted by the knurls will be equal and opposite and will have no tendency to deflect the work from the lathe axis, or to impose any side strain on the mandrel bearings. To fulfil these conditions, however, it is essential that the two knurls should be applied at diametrically opposite points on the work; the resulting forces are then solely rotational, that is to say the tool itself will tend to rotate with the work, but this is resisted by the shank pressing downwards against the lathe toolpost. When heavy knurling is undertaken on work of large diameter, this turning effort may be considerable and its value can be estimated by turning the lathe mandrel by hand while the tool is engaged. For this reason, it is not, perhaps, advisable when doing heavy knurling, to mount the tool in the ordinary form of back toolpost, as the strain is then in an upward direction and falls on the saddle T-slots and the attachment bolts; nevertheless, this is a very convenient way of doing light knurling and the progress of the work can easily be seen. When the knurling tool is in operation, the resistance felt in the hand feed as the knurls are moved along the work will generally be greater than that experienced when traversing an ordinary lathe tool; to withstand this side strain, the knurling tool must, therefore, be robustly constructed

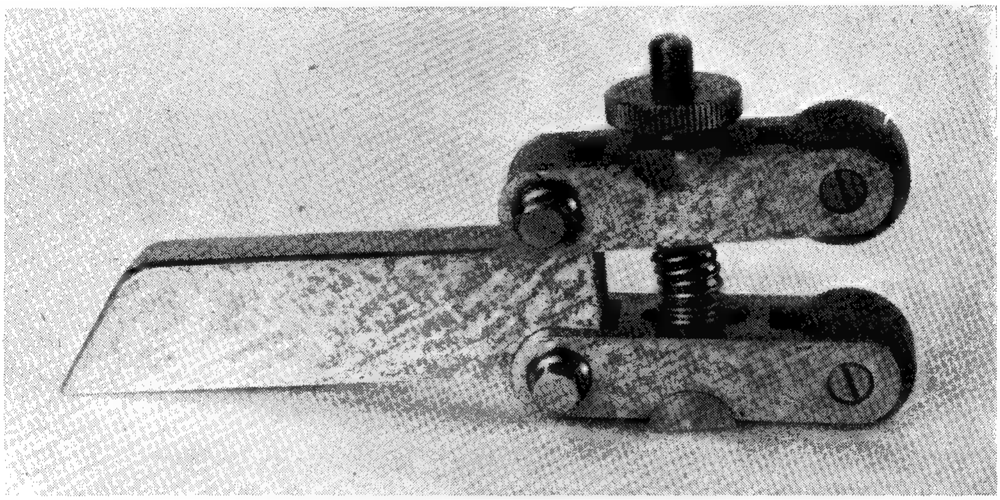


Fig. 1

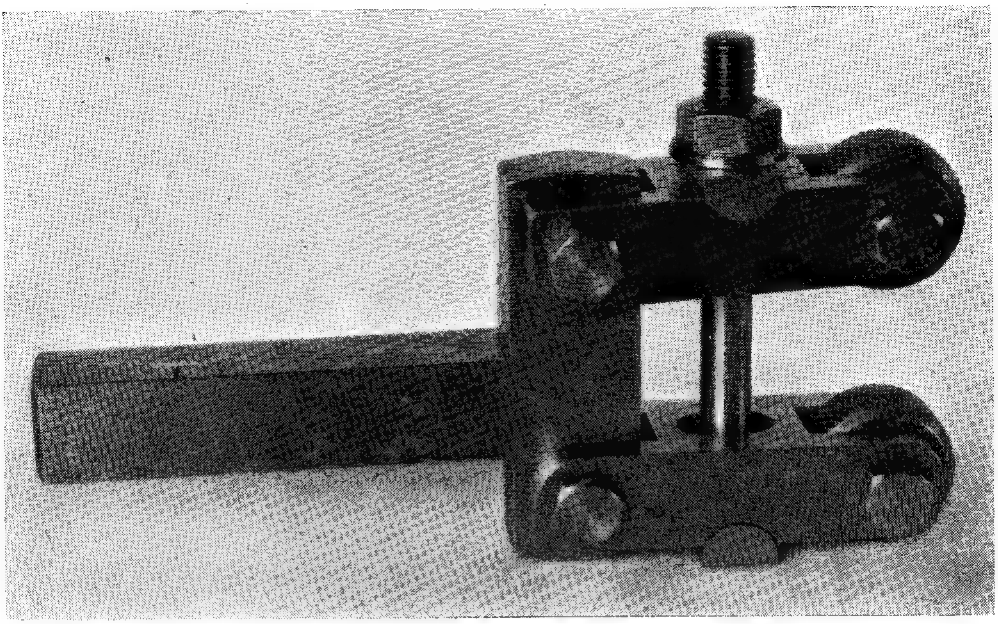


Fig. 2

and have enough rigidity to overcome any tendency to bend or whip even when heavily loaded. It is for this reason that the individual parts of the tool have been machined from the solid and afterwards very closely fitted; in addition, the components are case-hardened to resist wear and mantain accuracy in the moving parts.

Constructional Work

The following constructional details apply to the tool illustrated in Fig. 2, which has a working capacity of from 3/32 in. to 1¼ in. Should a larger tool be required, the depth of the throat can be increased by lengthening the arms and, at the same time, the hinge joints of the arms are spaced farther apart. The main components

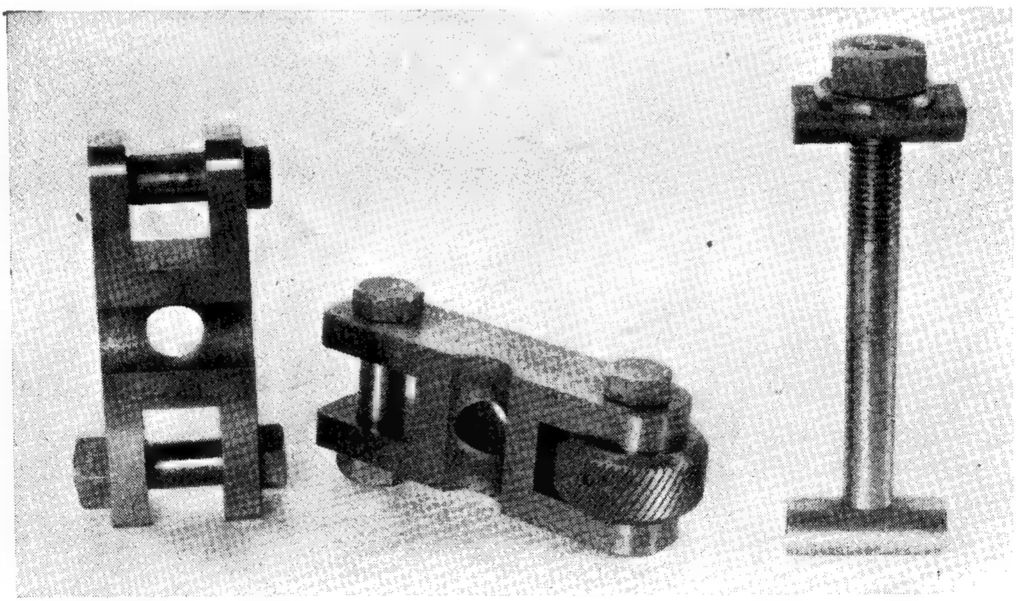


Fig. 3. *The arms and pressure-bolt*

with their fittings consist of : the arms (*A*), the body (*B*), and the pressure bolt (*C*).

The Arms

These two parts [redacted] exactly similar in construction, except that one is made, as it were, right-handed and the other left ; this is done in order to locate all the bolt heads on the side away from the chuck. As depicted in the working drawings in Fig. 5, the [redacted] made from the solid, using mild-steel bar $\frac{1}{2}$ in. by $\frac{3}{8}$ in. After the material has been filed flat and square, it is marked-out ; this is followed by forming the bores to receive the hinge pins and those for the wheel pivots.

Tapping-size holes are first drilled with a No. 3 drill right through all four ends, and these bores are then enlarged to the reaming size for [redacted] depth of just over $\frac{9}{16}$ in. Although [redacted] letter "D" drill, which is 4-thousandths of an inch undersize, is generally used for the latter purpose, reaming will be found easier, if instead, [redacted] 6.3 mm. drill is employed, for this is only 2-thousandths under the nominal size. A $\frac{1}{4}$ in. B.S.F. tap is now entered in the reamed holes to thread the remaining portion of the bores.

The next operation is to form the forked ends of the arms ; this was done by first removing the surplus metal with a hacksaw and file and then gripping the parts in [redacted] machine vice attached to the lathe cross-slide. A circular milling cutter, mounted on [redacted] arbor between the lathe centres, was next employed to finish the slots to the correct width and depth. When doing this, the arms were set in the vice so the cutter entered to the required depth, and the width of the slots was determined by working to readings on the lead-screw index. Another way of forming the slots is to grip the work in a machine vice attached to the vertical slide and to do the machining with [redacted] end-mill, but an end-mill used in this way does not always give such [redacted] good surface finish, and moreover, it is then perhaps rather more difficult to cut the slots accurately to size. Before removing the first part from the vice, make sure that the knurling wheels enter the slot freely but without side play. Best quality knurls are accurately ground to width [redacted] the side faces, and the bores

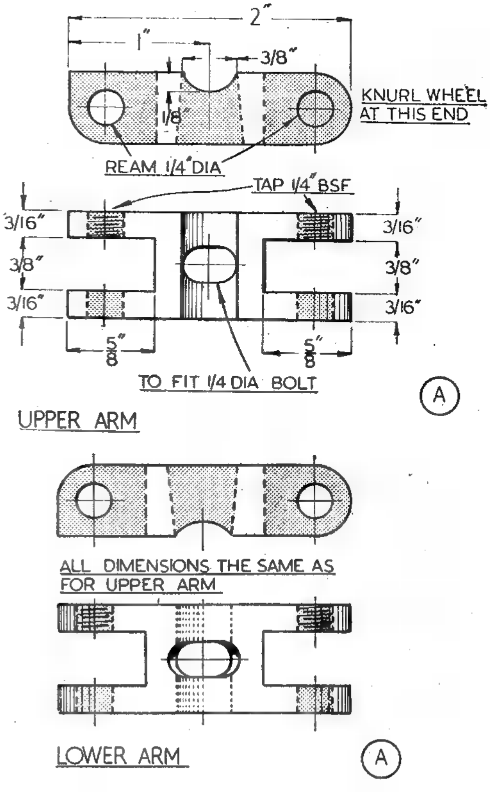


Fig. 5. Details of the two arms

are also sized by grinding. Nevertheless, the bore diameter should be checked so that any undersized bore can be corrected by lapping.

An accurate method of determining the bore size is illustrated in Fig. 6 ; the wheel is moved along [redacted] ground, taper mandrel until the place is found where it becomes a close running fit ; a mark [redacted] then made with a grease pencil, and the diameter of the mandrel at this point is measured with [redacted] micrometer.

This procedure is also instructive in that it will show the difference in diameter required for [redacted] running fit, [redacted] light push fit, and [redacted] firm fit, but when testing a hardened part in this way the bore should first be oiled and care must be taken not to use such force [redacted] would damage the surface of the mandrel.

The hole for the passage of the pressure-bolt is now drilled, but it will be finished to its elongated shape at [redacted] later stage when assembling the arms on the body. The hollows to accommodate the pressure pads are best formed by clamping the arms in a machine vice, attached to the vertical slide, and then machining to a little less than the half diameter with a $\frac{3}{8}$-in. diameter end-mill.

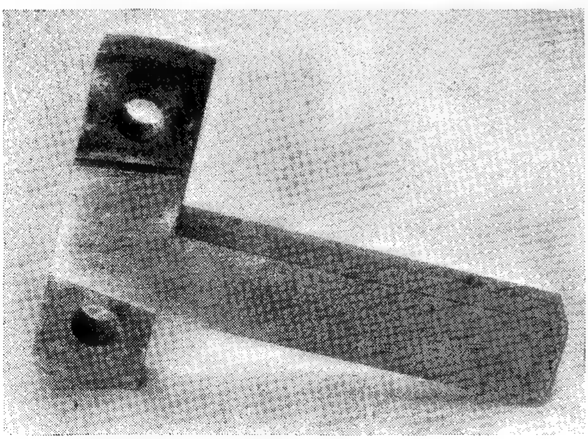


Fig. 4. The body of the knurling tool

The Body

The shank or body, shown in Fig. 7, is marked-out on a length of 2 in. by ½ in. mild-steel and cut to shape with the hacksaw and file. The dimensions given refer to a tool suitable for mounting in the tool turret of a 3½-in. Drummond lathe, but if any other form of mounting is used it is only necessary to ensure that the centre-line of the head portion lies at approximately the centre height of the lathe.

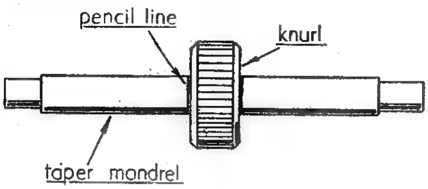


Fig. 6. Method of measuring the bore size of the knurling wheels

After the holes for the arm hinge-bolts have been located on the head, they are drilled right through and then reamed to size, as previously described. It now remains to machine the recesses on the head lugs to fit accurately in the slots cut in the inner ends of the two arms. This can be done conveniently by gripping the body by its shank in a vice attached to the vertical slide, and then cutting out the recesses with an end-mill or with a circular facing cutter. It will be noticed that the shoulders formed by these recesses lie at an angle of 8 deg. to the long axis of the part ; the vertical slide is, therefore, swivelled in either direction by this amount for the two stages of the machining operation. As the arms have to fit accurately and without shake on the head lugs, it is advisable to leave the lugs slightly oversize so that they can be hand-fitted during assembly by careful filing with a smooth file followed by scraping or oil-stoning. The fitting should be completed at this stage, and during this process temporary hinge-bolts should be used.

The Pressure-Bolt

As shown in Fig. 8, this consists of a ¼ in. diameter stud threaded 2 B.A. at its foot and ¼ in. B.S.F. at the upper end. The two pressure pads are made from a piece of ⅜ in. diameter round rod filed down until it is semi-circular in section. The lower pad is screwed on to the stud, which is then riveted over, but the upper pad is made a free sliding fit.

The pressure-bolt can now be put in place in the arms assembled on the body, but, to enable the arms to move over the full range, the holes through which the bolt passes must be filed to an oval shape.

The Hinge and Pivot-Bolts

To give a neat appearance, all four bolts are turned from 2 B.A. nut-size hexagon rod, and it is essential that they should be made an accurate fit in their reamed holes. The lock-nuts fitted to the two hinge pins are made from No. 1 B.A. hexagon rod which measures approximately ⅜ in. across the flats.

Case-Hardening

The next step is to case-harden the two arms and the four bolts. As the wheel pivot-bolts are heavily loaded when the tool is in operation, these parts at any rate should be deeply case-hardened. It will save trouble, however, if all six components are packed with a case-hardening compound, such as Antol, in a cast-iron receptacle and then heated in accordance with the manufacturers' instructions. If, after hardening, it is found that the parts fit too tightly, the pivot-bolts can be polished with a strip of worn abrasive cloth, but the arms are refitted by using an oil-stone or an India stone to remove the high spots. In this connection, it will be noticed that a spring for opening the arms has not been fitted ; the reason for this is that if the pressure of a small spring will move the arms, the fitting is not then sufficiently close to give the tool full working rigidity.

The hinge pins are fitted with lock-nuts as well as being screwed into the arms ; this allows the slots to be closed by a very small amount to counteract wear, but will hardly make up for indifferent fitting. The tool described has been in use for many years, but as yet there is no discernible shake in any of the moving parts. It might be thought that, for adjusting the tool, a knurled finger-nut would be more convenient than the hexagon nut shown, but when the knurls are set to the work while the lathe is in motion, the fingers may be perilously near to the jaws of the rotating chuck and it is then safer to use a small spanner.

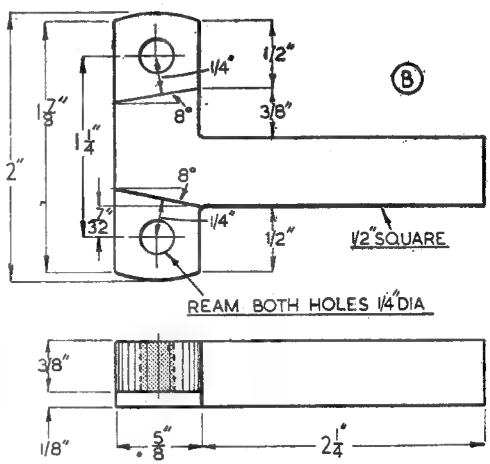


Fig. 7. Constructional details of the body

The Tool in Use

In the course of machining a part such as an adjustable index collar for a feed screw, one operation will be to knurl the rim to provide a finger-hold ; therefore, to avoid having to scrap the work when partly finished, it is essential that the method of knurling adopted should be certain in action and should also provide for the correction of any faults that may arise.

The difficulty most commonly experienced when knurling is that both wheels do not keep in step with the work. When this happens, the wheel on its first revolution makes a regular impress, but on the second revolution the tooth marks are formed between those previously cut, and this false knurling will be continued right along the work unless corrected at the start. After the part has been turned parallel and true, the knurling wheels are set across the diameter of the work to engage for a distance of ⅛ in. or slightly less. With the lathe running in the slow direct speed, the pressure-bolt is tightened with a spanner for some quarter of a turn after both wheels have started to revolve. The lathe is then stopped and the work is examined; should the knurling be found to be irregular, the lathe is

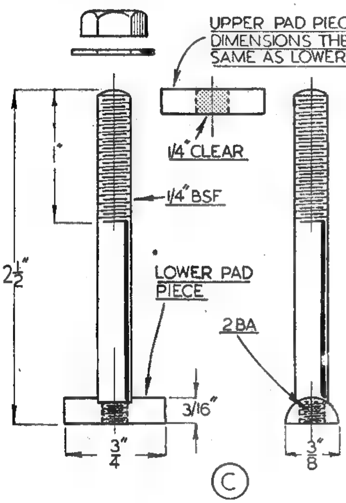


Fig. 8. The pressure-bolt

again started, and the pressure is increased. These operations are repeated until the knurling is satisfactory on the extreme end of the work, then, and only then, is the tool traversed along the work for the required distance.

Several traverses of the tool are usually needed to form the finished impress, particularly when coarse knurling is undertaken.

Although it is usually considered inadvisable to remove the tool from the work until the knurling is completed, no difficulty will as a rule be found in getting the wheels to pick up the pattern should they have to be re-applied to the work.

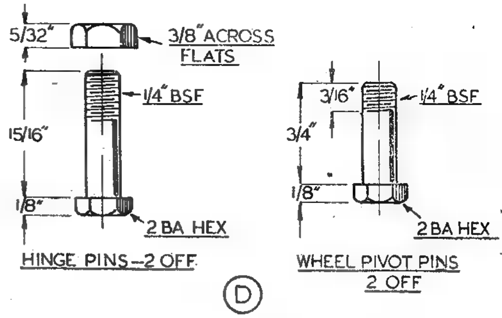


Fig. 9. Left—the arm hinge pins. Right—the wheel pivots

An even simpler method of starting the knurls correctly can be used, and this proved successful in every instance when a length of ⅝ in. diameter round mild-steel was knurled as an experiment.

After each test, the end portion of the rod was remachined to remove the knurling and a fresh trial made. In this way, the diameter of the rod was altered five times in all, so that there was no question of the work diameter matching the pitch diameter of the knurling wheels. The method adopted consists in lightly closing the knurls across the diameter of the work while stationary; the tool is then disengaged by moving the saddle towards the tailstock. Next, the pressure-nut is tightened for some quarter of a revolution, and with the lathe running, the tool is traversed along the work for a short distance. The lathe is now stopped and the work inspected. Should there be any sign of double-cutting, the tool is again withdrawn in the direction of, the tailstock and the pressure-nut is further tightened. When the knurling pressure is adjusted in this way, with the work stationary, there is no need to use a spanner as a matter of safety, and instead, a knurled finger-nut can be fitted for greater convenience in working. The greater depth of cut resulting from the increased pressure applied will serve to keep the knurls in step with the work, and it then only remains to traverse the tool and adjust the depth of cutting to complete the knurling operation satisfactorily.

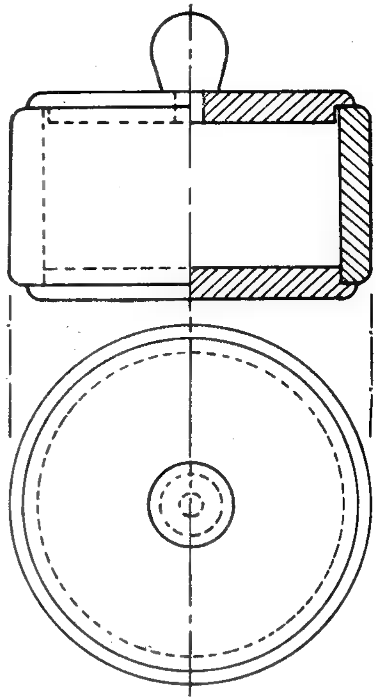
A Hand-Driven Generator

Messrs. Leslie Dixon & Co., Electradix House, 214, Queenstown Road, Battersea, S.W.8, have submitted to us a sample *ex*-Government d.c. hand-driven generator having an output of 6 V, 5 A, d.c., and fitted with hand-gearing, which enables this output to be obtained at a crank speed of 100 r.p.m. This is a very well made piece of apparatus, and could be adapted as a wind-driven dynamo, or by removal of the hand-gearing, could be driven by a small engine or motor for purposes of charging small batteries. It could also be used as a vehicle lighting dynamo. The machine weighs only 7 lb. and is sold at a low price, which bears little relation to its original cost.

PLASTIC POTS

by

P. W. Blandford



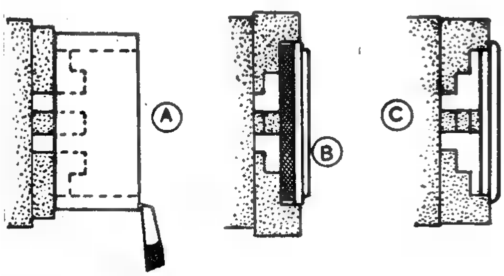
THE plastic Catalin is made in a variety of tube sections which are particularly suitable for making pots and jars. There is a choice of hundreds of colours, either opaque, transparent or translucent, with grained or marbled effects. Catalin is a cast synthetic resin—the moulds being of lead, and the common range of cylinders are 2 in., 3 in. or 4 in. diameter with a wall thickness of about ⅜ in. in lengths of about 8 in. Outsides may be plain, scalloped, fluted, octagonal or other shape.

A piece of tube about 2 in. long, with a couple of discs of sheet Catalin or Perspex about ¼ in. thick, can be turned into an attractive pot, which will serve on desk, dressing table, or dining table. I have two which have seen five years of continuous service as jam pots, taking their chance with washing up, and still bearing their original polish. In fact, just the thing for Christmas presents!

A number of variations in design will suggest themselves to the amateur turner, but the following steps in making to a basic design will serve as a guide.

All of the work may be done with a right-hand knife tool sharpened for brass, or preferably with a little negative top rake.

Chuck the tube and turn both ends true. If inside jaws are used (*A*), be careful to avoid over-



tightening, as there is not the feeling of solid resistance which is found with metal, and excessive tightening may split the plastic. Round the ends of the tube slightly with a file or a hand tool, and remove tool marks with fine glasspaper followed by a damp rag and pumice powder before removing from the lathe.

Saw and file, or preferably fretsaw, the ¼ in. sheet to shape—the diameter being about the same as the outside of the tube in the first instance. Chuck a disc, with a wood or card packing behind it, so that a little more than half projects from the jaws (*B*.) Turn a recess to make a push fit into one end of the tube. This will make the bottom. If the recess turns out to be a loose fit, that piece becomes the lid. If the bottom is a good fit, make the lid in the same way, but let it be an easy fit. Catalin cylinders have a very slight taper to allow them to be withdrawn from the moulds, so the bottom may make a better fit at one end than the other.

Hold each disc in turn by its recess and turn the outside to a diameter to suit about half the thickness of the tube wall, and round its edge in the same way as the end of the tube (*C*.) If the lid is to have a turned handle, drill the hole for its dowel before removing from the lathe.

The owner of a lathe will almost certainly want to turn a handle, but quite attractive handles can be made from triangular or other shaped pieces of scrap sheet plastic.

If the handle is a tight fit in its hole and the base is a good fit in the bottom of the tube, there will be little need for adhesive except for waterproofing the joint. If the correct adhesive is available, that should be used, but if waterproofing is the only concern, then a tube of "pear-drop" cement will do.

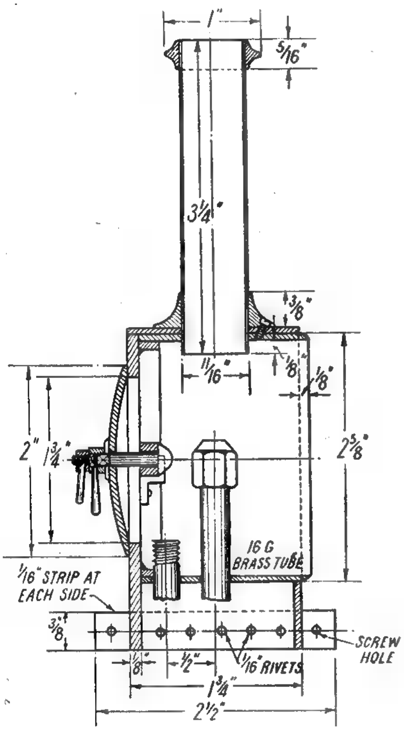
If the parts are thoroughly scoured with pumice powder first, a good polish can be obtained while they are rotating at a high speed by using metal polish on a rag. Should a buffing wheel be available, of course, that provides the best method of finishing.

If the pot is to be used for jam, a slot should be cut in the lid for the spoon.

"L.B.S.C.'s" Beginners' Corner

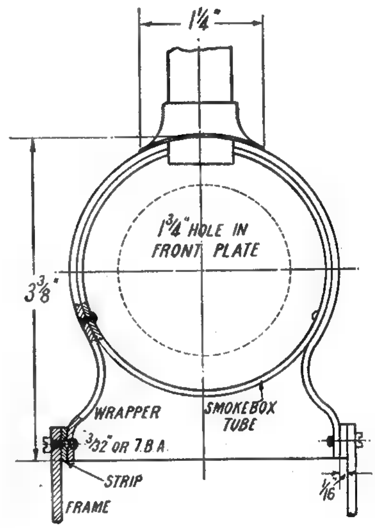
Smokeboxes for "Tich"

BEFORE making the boiler fittings, maybe it would be as well to make and fit the smokebox, so I'll deal with that component right away. The smokeboxes shown, for the large and small boilers, are rather different in construction. That for the smaller boiler is of what is sometimes known as Victorian type; the larger boiler might prefer the older pattern. If anybody wants to work either of these wheezes, it is perfectly easy; all you do, is follow the instructions for making and fitting the kind required, but change over the measurement, and use those appropriate to the size of the boiler.



Left—Section of smokebox for smaller boiler

Below—How to fix wrapper sheet



the wrapper, or outer sheet, comes right down to the frames, and is attached directly to them. It may be waisted in at the sides, as shown, or it may come down straight-sided, like the sides of the firebox. The front plate is flat, and fits closely to the contour of the smokebox, whether straight-sided or waisted. The smokebox for the larger boiler is of modern type, circular in shape, and supported on a saddle which is attached to the frames above the cylinders; the front of this one is a flanged circular plate, turned to a push fit in the shell. The door of each type of smokebox is of the same pattern, though of different size, the fastenings are also the same. When scheming out the design, I thought maybe that some builders who are fitting the smaller boiler, might prefer a circular smokebox with saddle, and vice-versa; those fitting

Making it Easy

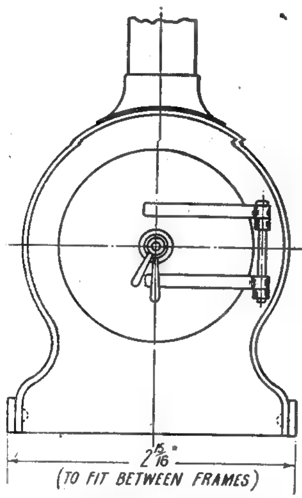
In full size, a smokebox of the older pattern would be made in a different way to the construction I shall specify. The smokebox tubeplate, instead of being like we made ours, would be a flat plate, of the same shape as the smokebox front; and the barrel would be attached to it by means of an angle ring. On the smokebox side of the plate, it would either be flanged—this would require a specially-shaped former—or else a shaped piece of angle would be riveted around the edge, and the wrapper sheet riveted to this in turn. The front plate of the smokebox would also be either flanged, or have the shaped angle attached, and it would be fixed to the wrapper sheet in the same way. The bottom of the smokebox would be closed by a flat plate; the whole would entail a lot of work, and unless

all the joints were brazed, it would be difficult to keep airtight.

We can get over all this trouble by the simple expedient of using [redacted] bit of tube pushed [redacted] to the end of the boiler barrel and forming an extension of same. The wrapper sheet of the smokebox is simply wrapped around this, the lower part being either left straight, or waisted in, [redacted] desired, then bent outwards and attached to the frames by [redacted] strip of metal at each side. No bottom plate is, of course, needed. The front is a piece of plate cut to shape, with [redacted] ring silver-soldered to it; the ring is cut to fit the end of the tube, and when pushed in, with a taste of plumbers' jointing smeared around it, the joint is airtight. One of the accompanying drawings shows the whole issue in section.

How to do the Job

The first requirement is a piece of 16-gauge brass or copper tube, $2\frac{5}{8}$ in. outside diameter, and [redacted] full $1\frac{7}{8}$ in. long. Steel tube *could* be used, [redacted] there is normally no water in contact with the metal; but I have found with steel smokeboxes, that sometimes when the engine is moved cold,



Smokebox front complete

a few drops of water come out of the blastpipe, and fall among the slight residue of ashes usually found clinging to the bottom of the smokebox. A corroding action is set up, and if the engine is not steamed for some time, the bottom of the smokebox first becomes pitted, and then goes into holes, which admit air, destroy the smokebox vacuum, and the engine fails to steam. I have just had to put [redacted] new bottom in the domestic coal pail, owing to the corrosive action of damp coke, which rotted the old one clean out. If a piece of tube is not available, roll up a piece of 16-gauge sheet metal, put [redacted] couple of rivets through the lap joint, and braze it, the process being the same as described for the boiler barrel.

Beginners should remember that whenever [redacted] piece of tube larger in diameter than the hole through the chuck body, is gripped in [redacted] three- or four-jaw chuck, using either set of jaws, the tube must be supported on the inside, to resist the gripping pressure of the chuck jaws. If it is held unsupported, it will fly out of the jaws as soon as the turning-tool starts operations on the end; and it will not only be badly distorted, but may damage your personal anatomy, or wreck the workshop window. Avoid trouble by putting something in the gripped end of the tube; [redacted] disc of wood, [redacted] old wheel, chuck plate or anything else that will fit. You can then tighten the chuck jaws down, and the tube will be gripped so firmly that it will "stay put" whilst the ends of the tube are squared off to length. I have squared off the ends of [redacted] 4 in. × 12 in. boiler barrel quite easily this way, although beginners would probably need [redacted] "steady" for a job that length, similar to that described for facing off long firetubes and superheater flues. Use [redacted] round-nose tool set crosswise in the rest, and a drop of cutting oil; and don't run the lathe too fast. "Slow and sure" is the motto for this job.

After facing off the second end, bringing the tube to [redacted] length of $1\frac{3}{4}$ in., round off the edge as shown; rough-turn it with the round-nose tool, then smooth it off to shape by holding [redacted] file to it. Don't drill any holes in it yet.

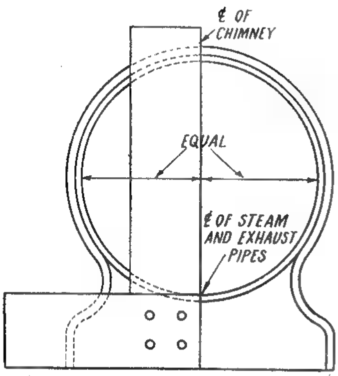
Wrapper Sheet

The outer wrapper sheet may be brass, copper, or steel, of 16-gauge. Cut a strip $1\frac{3}{4}$ in. wide, and 9 in. long, then bend it around the smokebox tube, to the shape shown in the illustration, leaving the sides straight, or waisted, as desired. the squared-off end of the smokebox barrel should be $\frac{1}{8}$ in. inside the wrapper sheet, and the rounded-off end should project $\frac{1}{8}$ in. beyond the wrapper sheet at the other extremity. Just above the place at each side, where the wrapper sheet leaves the tube, put in three $\frac{1}{16}$-in. countersunk rivets, to hold the sheet in close contact with the tube. If the riveting has distorted the bends, put them right again before proceeding further. I use [redacted] couple of small toolmakers' cramps to hold one side in position whilst riveting, then remove them, pull the strip of metal tightly against the barrel, and put the cramps on at the opposite side. After riveting, which is done in the same way as the lap seam of the barrel, heads inside, the stems hammered flush into countersunk holes outside, and filed flush, the bends are fettled up; and if one side is longer than the other, it is cut to correct length, so that the smokebox will stand up perfectly straight on [redacted] level surface. This is important; otherwise the chimney will either emulate the Leaning Tower of Pisa, or be off centre, which looks worse still when the engine is viewed from the front.

Stand the embryo smokebox on something level, and put [redacted] square against the front, adjusting same until the distance from the edge of the square's blade, is exactly the same to either side of the smokebox, at the centre line. Now, exactly where the edge of the square rests against the top of the smokebox, make [redacted] mark; and from that, draw a line along the top. This will indicate the extreme top; halfway along,

make a centre-pop, which indicates the exact spot to drill the hole for the chimney. From this, scribe [redacted] circle $\frac{11}{16}$ in. diameter, with [redacted] pair of dividers ; make [redacted] good deep scratch. Drill [redacted] $\frac{1}{8}$-in. hole at the marked spot, and follow with $\frac{1}{2}$-in. drill ; you'll probably find that the drill has wandered, and the hole isn't in the middle of the circle. Correct it with [redacted] file, then put [redacted] bigger drill through ; or if you like, file out the hole until you just barely touch the line, and finish with an $\frac{11}{16}$-in. parallel reamer, put through by hand. A lot of fuss, maybe, but it is worth it to get the chimney up straight ; you'd say so, if you had seen what I have seen !

Stand the smokebox up again, apply square, and mark off extreme bottom line by similar process. Make [redacted] centre-pop in the middle, and another one at $\frac{1}{2}$ in. toward the front. These



How to locate chimney and pipe holes

are for steam and exhaust pipes ; drill and ream as above, finishing to $\frac{5}{16}$ in. diameter. It is important to get the hole for the blast pipe exactly under the chimney.

Smokebox Front

The front of the smokebox may be a casting, or made up from $\frac{1}{8}$-in. brass plate, with a ring silver-soldered to it. If [redacted] casting is used, chuck it by the door hole, putting the inside jaws of the chuck through the hole, and opening them out. The ring may then be turned to [redacted] tight push fit in the smokebox barrel using [redacted] knife tool. Next, chuck the casting the other way around, gripping the turned ring in the outside jaws, setting it to run truly. Face off the whole of the front with [redacted] round-nose tool set crosswise in the rest. The edge can be cleaned up with a file, to the contour of the wrapper, so that it fits neatly when the ring is pressed into the barrel.

To make [redacted] built-up front plate, stand the smokebox end-up on [redacted] piece of smooth flat $\frac{1}{8}$-in. brass plate, and scribe [redacted] line all around the outside. By the good rights, the line should be scribed around the inside, but the barrel gets in the way. Anyhow, it is easy enough to mark out another line inside the scribed one, at a distance of $\frac{1}{16}$ in. away. Saw the plate roughly to shape, and finish with [redacted] file until it fits exactly in the front of the smokebox wrapper, bedding up against the end of the barrel. Leave it in, turn the smokebox the other way up, and scribe [redacted] line [redacted] the plate, all around the inside of the barrel. This circular scriber mark shows the exact place to put the ring. Find the centre of it, either by trial and error with [redacted] pair of dividers, or by the geometry method you were taught at school, or the same way as your humble servant does, viz., put [redacted] rule across it vertically and horizontally, so that the edge of the rule crosses the approximate centre, making [redacted] scratch "by eye" [redacted] near the middle as possible, in both directions. Put one point of the dividers at the middle of the cross, set the other to the circle, and the odds are that you will be within $\frac{1}{16}$ in. of the true centre when you sweep the dividers around. If you haven't hit the true centre, you'll see at [redacted] glance, where it is ! Make [redacted] centre-pop on it ; and from that, scribe another circle $1\frac{3}{4}$ in. diameter. Either cut out the piece with a metal fretsaw, or drill [redacted] circle of holes inside the line and break out the piece, filing away the ragged edge. My own pet wheeze is to chuck the plate in the four-jaw, with the scribed circle running truly, and cut it out with [redacted] parting-tool set crosswise in the rest. This leaves [redacted] very clean hole which needs no filing, except to take off the sharp edges.

Dead Easy

Soften [redacted] bit of $\frac{3}{16}$-in. square brass rod about $8\frac{1}{4}$ in. long, by heating to red and plunging into cold water. Bend it to [redacted] circle $2\frac{5}{8}$ in. outside diameter. Clean it up, lay the smokebox front in the brazing pan, with the ring on it—this should come practically flush with the edge of the circular part—and silver-solder it, using best grade silver-solder, or "Easyflo." After the practice beginners have had, in brazing up the boiler, they should all find that job as easy as eating [redacted] piece of cake ; merely anoint the joint with wet flux, blow up to medium red, and apply the silver-solder. Tip : Use [redacted] big diffused flame, to heat the work evenly ; if you don't, the front plate will buckle. By the same token, says Pat, let the job cool to black before dropping it in the pickle ; otherwise, it will go all shapes. If you should happen to be unlucky, don't despair, but just lay it on something nice and flat, and do what Bert Smiff calls "'it it wiv an 'ammer," but use care and discretion. Outside my workshop door is [redacted] small blacksmith's anvil, on a wooden stand, which comes in handy when anything wants [redacted] good "biffing," and is just the berries for [redacted] job like this. Incidentally, when I first put it there, [redacted] of my few personal friends promptly chalked GRETNA on it, saying that any run-away couple in this locality needn't waste their money on a train journey on the L.N.E.R. ; the inscription stayed until finally Jupiter Pluvius washed it off. Young Curly's first "anvil" was a discarded flat-iron, begged off mother, and mounted upside down minus the handle, on a block of wood.

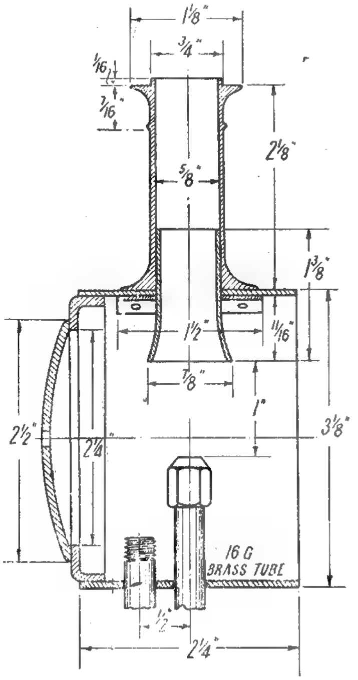
The front plate, with the ring silver-soldered to it, is now the equivalent of a casting as mentioned above, and it is treated the same way, chucking by the hole, turning the ring, then reversing and truing up the front. We will

fill in the back, and fit the side strips when we come to the erecting job.

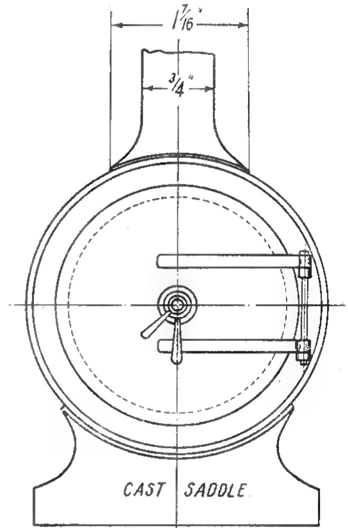
Smokebox for the Larger Boiler

As the door and hinges, dart and crossbar fastening, and locking handles are made in the same way for both the larger and smaller smokeboxes, one description will do for both ; so if I now describe the larger smokebox shell and front, builders of both sizes can then go right ahead. The shell of the larger smokebox is merely ■ piece of $3\frac{1}{8}$ in. diameter brass or copper tube, 16-gauge, and a little over $2\frac{1}{4}$ in. long. Chuck it in the three-jaw, using a disc, or other packing, pressed into the end which is being held in the chuck, and square off each end until the piece of tube is exactly $2\frac{1}{4}$ in. long. Scribe ■ line across it, and in the middle of the line, make ■ centre-pop ; from that, scribe ■ $\frac{5}{8}$-in. circle, and make ■ $\frac{5}{8}$-in. hole exactly as described above, for the chimney of the smaller smokebox. Exactly opposite, scribe another line across the shell. I have ■ very flexible steel rule, almost like a piece of metal tape, which can be wrapped around even ■ small-diameter tube. I usually measure the circumference of the smokebox shell with this, then it is easy enough to mark off half the dimension, measuring from the centre of the chimney hole, or from the centre-pop before the hole is drilled. A tape measure, as used by your wife, sister, or girl friend, as the case may be, will serve the same purpose.

In the middle of the line, make a centre-pop, and another one $\frac{1}{2}$ in. away ; both these are drilled and opened out to $\frac{5}{16}$ in. diameter, for the steam and exhaust pipes, same as previously described for the smaller smokebox. No outer wrapper sheet is needed, as the smokebox is supported by a separate cast saddle, as shown.



Section of smokebox for larger boiler



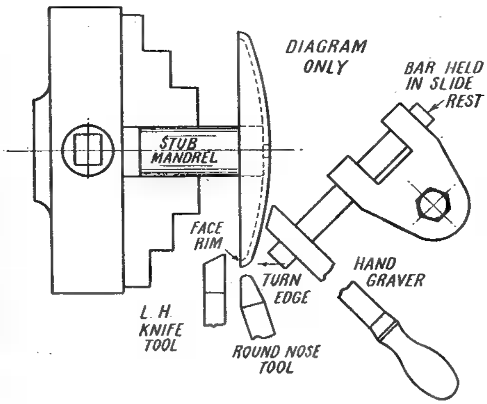
Complete front, showing saddle mounting

Smokebox Front

The front may be either ■ casting, or flanged up from plate. In the former case, chuck it on the inside jaws of the three-jaw, by the hole ; turn up the outside edge to a tight push-fit in the smokebox shell. Round off the edge, as shown. Reverse in chuck, and grip by the turned flange, convex side outwards. Face the full diameter with ■ round-nose tool set crosswise in the rest. If the front has hinge lugs cast on, it prevents the whole front being faced off, and there are two courses open to the builder. If the casting is at all rough, it would be best to make ■ clean sweep of the whole lot, and face the entire front, cutting off the cast-on lugs in the process. Separate lugs can be fitted afterwards, as will be described for the flanged-plate front. If the casting is clean, leave the lugs on, and just face off ■ section $2\frac{1}{2}$ in. full diameter, just big enough to accommodate the door. If the hole is ragged, true it up with ■ boring tool.

To make ■ flanged-plate front, cut out a circle of $\frac{1}{8}$-in. brass (doesn't matter if it is ■ little thinner ; 12-gauge would do) to $3\frac{3}{4}$ in. diameter ; or use ■ commercial stamped brass blank, same as I

usually do. Soften it, and flange it exactly as described for the smokebox tubeplate. It will probably need annealing three or four times during the flanging process; brass is more brittle than copper, and is, therefore, more liable to crack. When you have a nice flange, chuck in three jaw, flange outwards, using the outside jaws, and face off the ragged edge. Then reverse it in the chuck, and hold it on the outer edge of the top step of the outside jaws. It cannot be mounted on the inside jaws, as you will find if you try it! Put a parting tool in the slide-rest, setting it crosswise, a weeny bit above centre, and cut a hole in the plate 2¼ in. diameter, using low speed and plenty of cutting oil. As there is plenty of clearance behind the plate, you needn't fear a broken tool when it breaks through. Then face off the rest of the front of the plate; turn the flange to a tight fit in the smokebox shell, and round off the edge. Bevel it with the turning-tool, and finish off with a file, with the lathe running at medium speed.



How to turn smokebox door made from plate

Smokebox Door

If a casting is used for the smokebox door, it will have a chucking piece cast on, in the middle of the convex side. Grip this in the three-jaw, set the casting to run as truly as possible, then face off the edge of the door until you have a true circle approximately ⅛-in. wide, which will close airtight against the smokebox front when the door is erected. An airtight joint is essential; if air leaks in, the vacuum in the smokebox is destroyed, and no air will be drawn through the fire, which will either burn very dull, or go out altogether. If the hinge straps are cast on the door, it will not be possible to true up the outside of it in the lathe. Centre the door with a centre-drill, before removing it from the chuck, and drill a No. 30 hole well into the chucking piece. Remove door, saw off the chucking piece, and clean up the outside of the door with a file, finishing with emery-cloth. Drill a No. 51 hole through each boss on the ends of the hinge straps, to accommodate the pin.

Made from Plate

A door may also be made from a disc of ⅛-in. sheet brass, or a commercial stamped brass blank of similar thickness. This should be a little larger in diameter than the size of door required; say, 2¼ in. diameter for the smaller boiler, and 2¾ in. for the larger. First job is to "dish" the blank; that is, alter its personal appearance from flat to saucer shape. Make it red hot, and plunge into cold water; then lay it on a block of lead, and hit it with the ball end of the hammer, starting from the middle and working outwards, all around, until you get the desired shape. Some folk say the dishing should be started from the edge of the disc; different folk have different fancies—all I can say is that I always start from the middle, and there is nothing amiss with the smokebox doors on any of my engines. When the "saucer" is complete, chuck it in three-jaw with the concave side outwards, setting it to run truly. Centre it, and drill right through with No. 30 drill; then face off a little piece around the hole, to about ⅜ in. diameter. Chuck an odd stub of brass rod, about ½ in. diameter, in the three-jaw and turn a pip on the end, about ⅛ in. long, to a tight fit in the hole in the embryo door. Squeeze it in, making sure that the shoulder around the pip is in close contact with the faced-off bit of the door. Put a drop of Baker's fluid, or other liquid soldering flux, around the stub, and a bead of solder alongside it. Hold the lot over a gas or spirit flame until the solder melts and forms a fillet all around the stub. When cool, wash in water (if any soldering fluid gets on to the chuck jaws, they will go rusty) then chuck the stub in the three-jaw. If the stub has been properly fitted, the dished plate will run truly; if not, a judicious tap or two with a lead or hide-faced hammer (what the engine shopmen of my generation used to call a "bacon-rind" hammer) will teach it better manners. The whole issue can then be finished off at the one chucking.

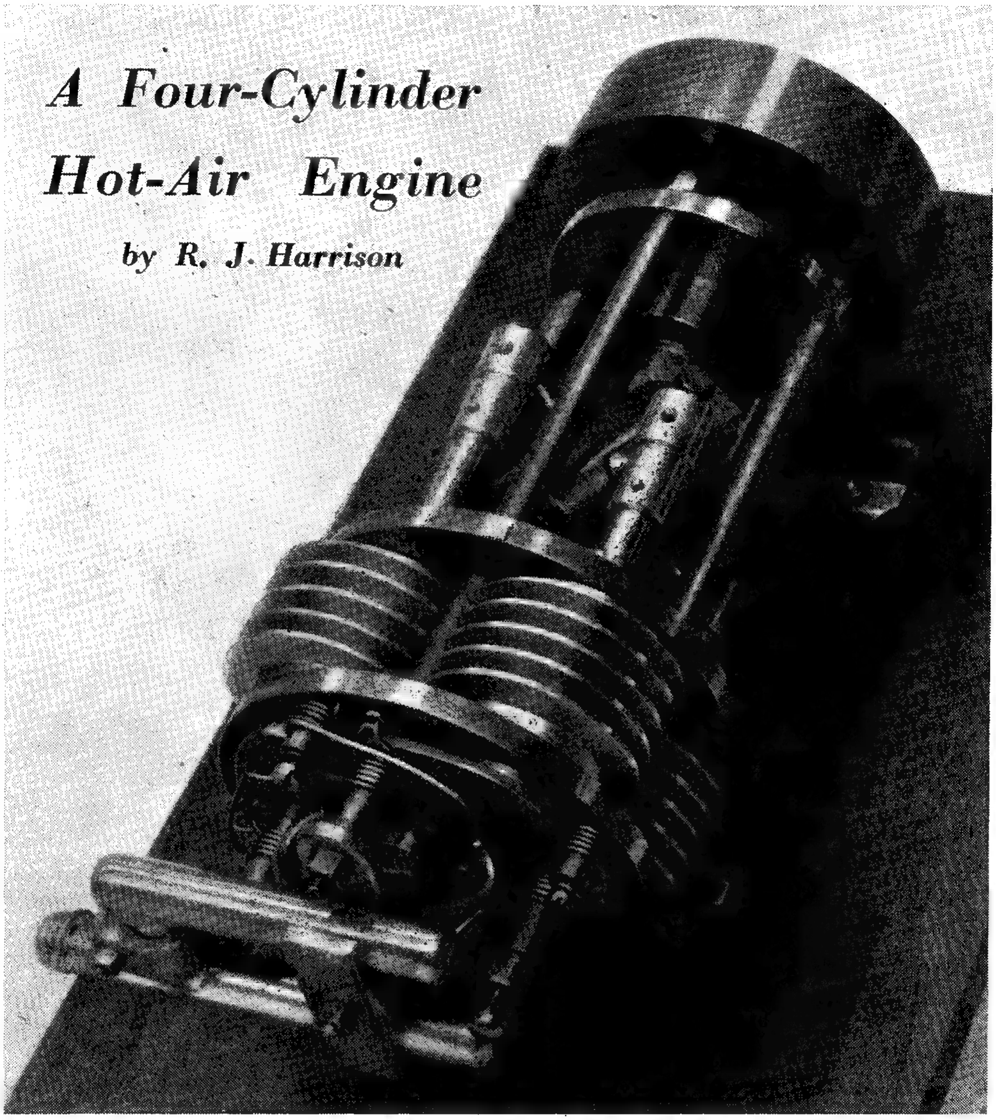
Finishing

Turn the outer edge to diameter with a round-nose tool; face the contact edge either with a left-hand knife tool, or a parting-tool carefully fed straight in; and the outside can be roughed with a round-nose tool set crosswise in the rest, operating both slide-rest handles together. Beginners won't be able to get a smooth finish by that method—nor very few experienced workers could, either!—and the way I finish mine, is to put a bit of bar in the rest, as shown in the accompanying sketch. A graver, which is a hand turning-tool made by grinding off the end of a bit of square tool steel to a diamond shape, is rested on the bar, and the cutting edge applied to the convex surface of the door. A little judicious manipulation [illegible] makes hay of the "'umps and 'ollers," and a piece of fine emery-cloth, or other abrasive, puts a finishing touch to the job.

Heat it up again to the melting point of solder, pull out the stub, wipe off any superfluous solder, and we are all ready to fit the hinges and fastenings.

A Four-Cylinder Hot-Air Engine

by R. J. Harrison



THE operational principle of this engine was very clearly described in THE MODEL ENGINEER of September 14th, 1950, so I will, therefore, confine myself to a few notes on its construction.

Small Power

No small part of the interest in designing and making this model was the knowledge that the power available would be very little indeed, as the pressure on the pistons could only be considerably less than atmospheric pressure, and that unless everything was just about right, it was quite probable that the engine would not work at all.

It took 18 months (spare time) to design and make and then four months to get it to run satisfactorily. The crankshaft is of the " Z " type and was built up from silver-steel with mild-steel webs. The two webs were drilled and reamed in one piece (see sketch) to ensure alignment, being cut apart and filed to shape afterwards. The portion of each web between the shaft holes was split with a piercing saw, a clamping bolt and nut being fitted to each. When adjusted to run truly, taper pins were fitted through each shaft end.

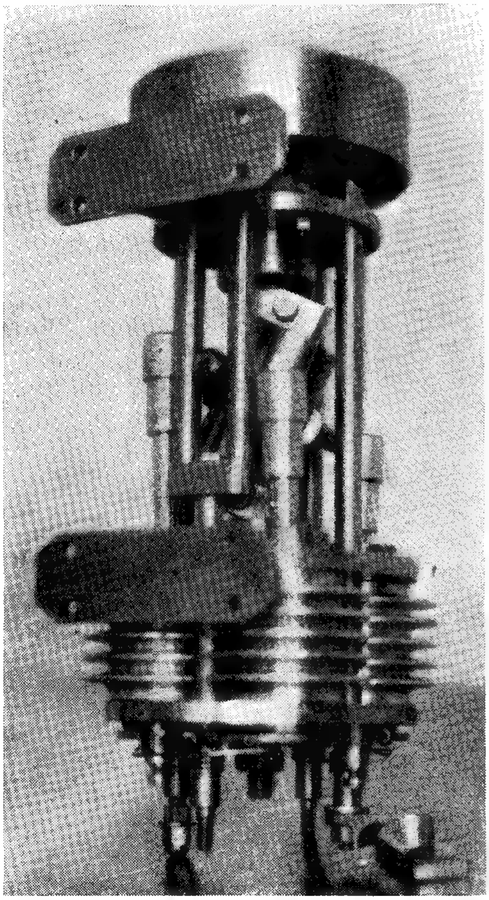
The flywheel is secured to the crankshaft with the usual split collar and nut.

Alignment

The crankshaft runs in ball-races, the flywheel

end having a plain bearing in addition. To ensure exact alignment of the plain and ball-bearings, the ball-race was pressed into its housing and the reamer (made from a piece of the silver-steel used for the crankshaft) entered through the centre of the ball-race to ream the plain bearing. This entails dismantling the ball-race afterwards to clean out the swarf, but is well worth while.

The bearing for the camshaft is also ball-race and plain bearing, so was produced in the same way.

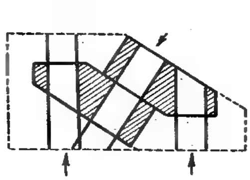


View of underside, showing roller and guide-rods

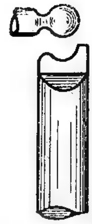
The centre crank bearing is a brass sleeve with a ball-race at either end and carries four radial arms which are ball-ended to fit in adjustable sockets on the ends of the connecting-rods. This assembly is prevented rotating by a fifth radial arm carrying a roller which works between two guide rods on the underside of the engine.

Turning Ball-ends

The ball-ends were turned with a form tool, made by drilling and reaming a $\frac{1}{4}$-in. hole in a piece of silver-steel and cutting off the end to

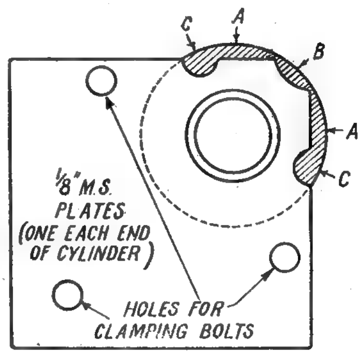


Two crank webs drilled and reamed in one piece



Form tool for turning ball-ends

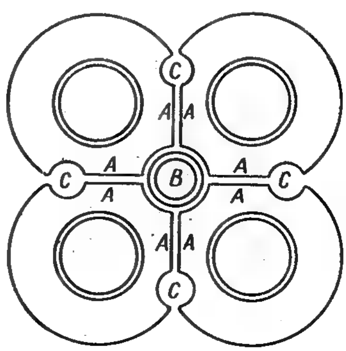
remove exactly half the hole. The remaining half hole was backed off in all directions, hardened, tempered and sharpened with an oilstone slip. This tool, set to centre height and using slow speed and plenty of lubricant, produced quite nice ball-ends in mild-steel, which were subsequently case-hardened, and polished with diamantine in a $\frac{1}{4}$-in. reamed hole in a piece of brass.



Shaded parts of fins filed away to clear :— "A"—adjacent cylinders; "B"—camshaft housing; and "C"—stay-rods

The cylinders are steel with dural sleeves shrunk on and turned to form fins. The cylinder bores were lapped on an expanding lead lap and polished with diamantine on a brass lap.

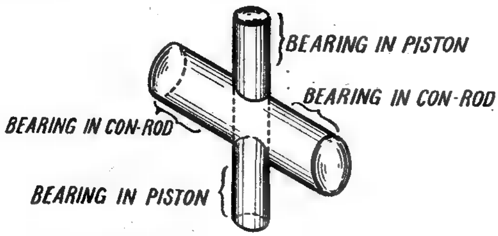
The dural fins were filed flat on two sides to clear the adjacent cylinders with a quarter-



Position of cylinders when assembled

circular recess between the flats to clear the camshaft housing. For this, a filing jig was made of $\frac{1}{8}$-in. steel plates shaped to the required outline of the fins and clamped to each end of the cylinder (see sketch).

Pistons were turned a tight fit in the cylinders and lapped in with oil only, high spots being removed with the oilstone slip. This process was repeated many times till a satisfactory fit



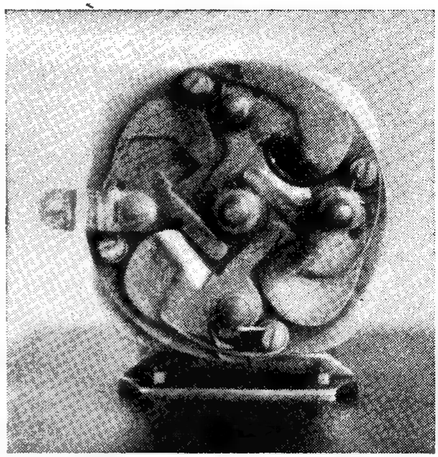
Enlarged sketch of little-end universal joint

was obtained. No rings are fitted to the pistons but three oil grooves are turned near the crown of each.

Valve Operation

The four cover valves are actuated by a single cam being opened by spring pressure and closed by the cam. A light spring holds each valve in contact with the end of its cylinder. The valves were ground flat, case-hardened and polished with diamantine on plate glass. The rear ends of the cylinders were also lapped on plate glass, and this produced an airtight seal.

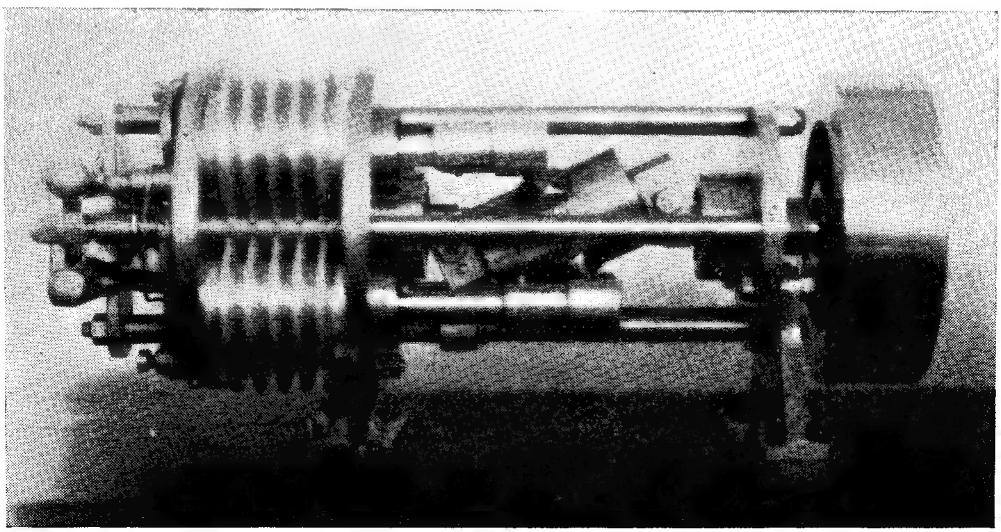
The little-ends of the connecting-rods have to be universal joints owing to the slight "figure of eight" motion of the ball joints at the other ends of the connecting-rods. These little-end universals are of the two-pin type (see sketch).



Rear view with burner removed to show valve gear

Speed

The engine runs at a steady 480 r.p.m. but, as expected, does not produce much power. But why worry about that? It was not designed or built for a power plant but simply for interest, and this it has given me in plenty. The curious motion of the "Z" crank and connecting-rods is quite fascinating to watch, and even the puzzle of getting it to run was most absorbing.



General view of four-cylinder axial-type hot-air engine

Novices' Corner

Calipers

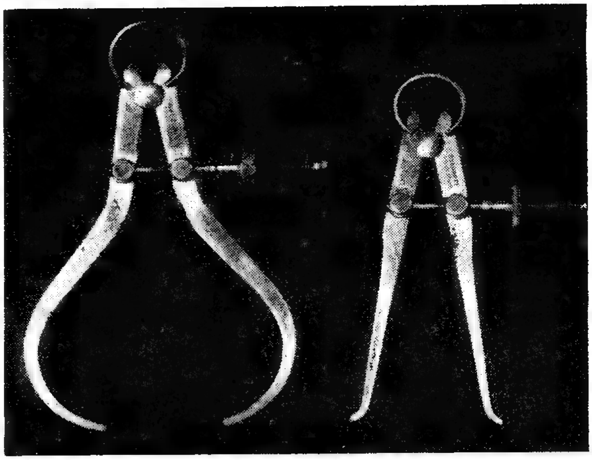


Fig. 1. Left—outside calipers. Right—inside calipers. Both have plain spring joints

CALIPERS are, perhaps, amongst the oldest forms of tools used in the workshop for estimating the size of work-pieces, and although, needless to say, they have been much elaborated in recent years, the essential principle of two legs moving on a hinge joint remains.

Inside and Outside Calipers

The actual form of the tool varies with the duty it has to perform; thus, the outside calipers shown in Fig. 1 have the legs bowed so that they can more readily be applied to work of large diameter. The corresponding inside calipers, however, have straight legs with the tips bent outwards to enable the tool to enter a narrow bore. In tool merchants' lists the size of calipers is stated in inches; this measurement refers to the distance between the pivot joint and the tips of the legs. For dealing with work of moderate size, 3-in. calipers will generally be found most convenient, as their light weight is an aid to sensitive handling.

Thread Calipers

The overall diameter of a screw thread is usually measured with a micrometer, but calipers are made for this purpose with broad tips to the legs so that the crests of several threads are included. When measuring the core or root diameter of a thread, the tips of the legs must be so shaped that they can make contact with the bottom of the thread. For estimating the core diameter of an external thread, the tips are, therefore, made chisel-shaped, but for internal thread measurement the contact tips are formed with needle points. These two forms of thread calipers are illustrated in Fig. 2.

Marking-out Tools

The two types of calipers shown in Fig. 3 are in common use for marking-out work; these are the dividers and the jenny calipers. The two legs of the dividers have sharp points for scribing circles or for laying off an exact distance from a fixed point. Jenny calipers have the tip of one leg inturned to form a guide when held in contact with the work, and the other leg is furnished with a scribing point, which is best made detachable so that it can be removed for sharpening and afterwards set to the correct length in relation to the guide leg.

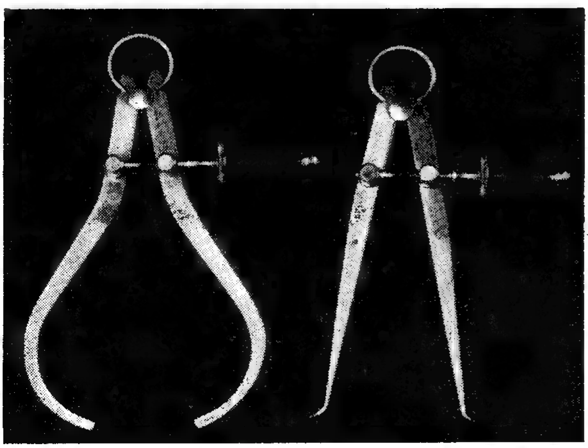


Fig. 2. Left—outside thread calipers. Right—inside thread calipers

The Pivot Joint

It is essential that this joint should work smoothly and, at the same time, keep the two legs in proper alignment.

In the older and cheaper patterns of calipers, the joint is made with a simple rivet, which is closed by hammering when tightening becomes necessary. The newer form of the so-called

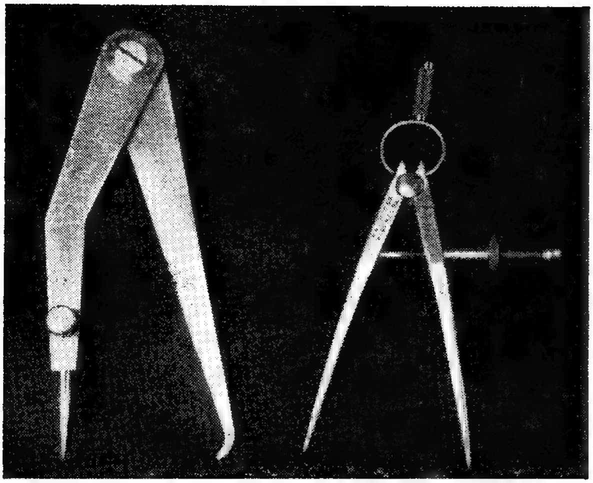


Fig. 3. Left—jenny calipers with firm joint. Right—dividers with hinged spring joint

firm joint consists of a screw passing through both legs and engaging in a nut on the far side. If well-made, this forms a satisfactory joint, but oiling and adjustment may be found necessary from time to time to maintain proper working.

When buying calipers fitted with a firm joint, the legs should be moved over their full range to ascertain that they work smoothly and evenly at all points.

As illustrated in Fig. 4B, the rivet and screw joints have now been largely displaced by a form of spring joint in which the hardened joint pin fits into curved slots formed in the upper ends of the two legs; the bow spring then serves both to keep the parts in position and to spring the legs apart. Should the spring have to be removed to dismantle the joint for cleaning, this can easily be done in the manner illustrated in Fig. 5; the caliper legs are first brought close together to expand the spring fully; a piece of tapered brass strip is then pushed into the bow; if the legs are now opened, the spring will be held expanded and can be removed. To fit a new spring, the same brass wedge is carefully pressed into the bow and, when sufficiently expanded, the spring can be assembled on the legs mounted on the pivot.

The second type of spring joint shown in Fig. 4C is of rather more elaborate construction and, here, the joint pins serves to join the two legs together by means of a true hinge joint.

The Setting Mechanism

Firm joint calipers are not usually furnished with a device for setting the legs, and adjustment is then made directly by hand and by tapping one leg against a piece of wood for the final, exact, setting. Spring joint calipers, on the other hand, are adjusted by means of a screw and nut, as can be seen in the various photographs. This screw mechanism has been elaborated by fitting a quick-acting form of nut which allows the legs to be opened to the full extent without having to turn the finger nut. The drawing,

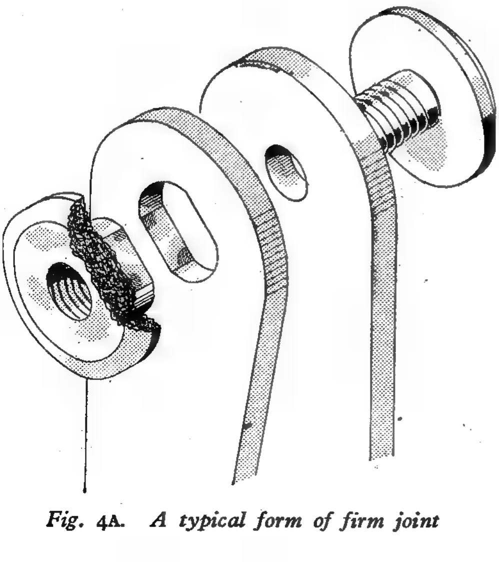


Fig. 4A. A typical form of firm joint

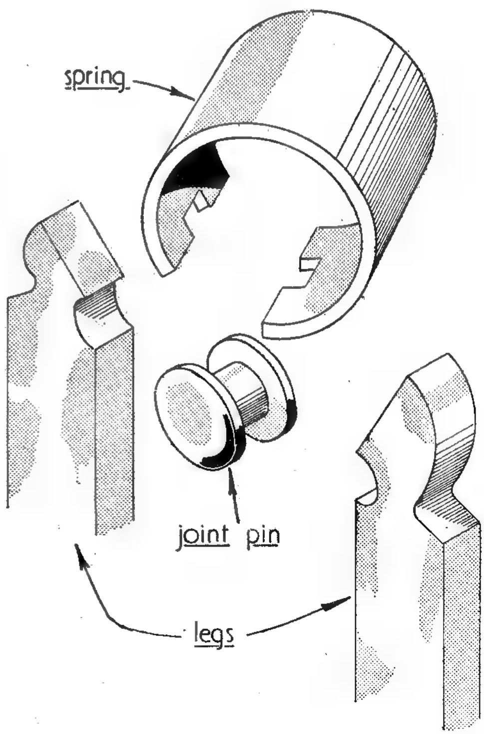


Fig. 4B. Usual form of spring joint

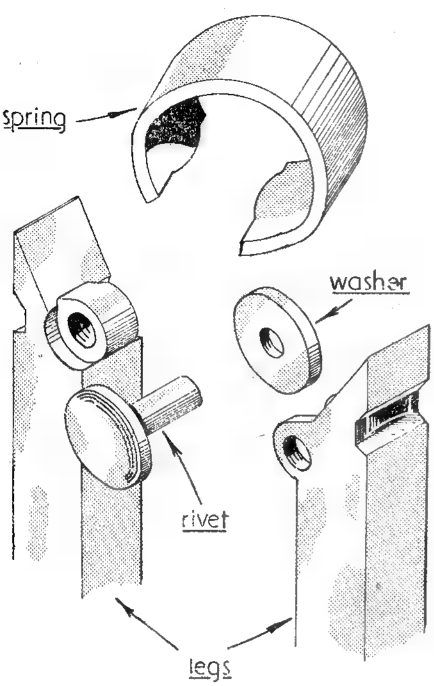


Fig. 4c. *A hinged spring joint*

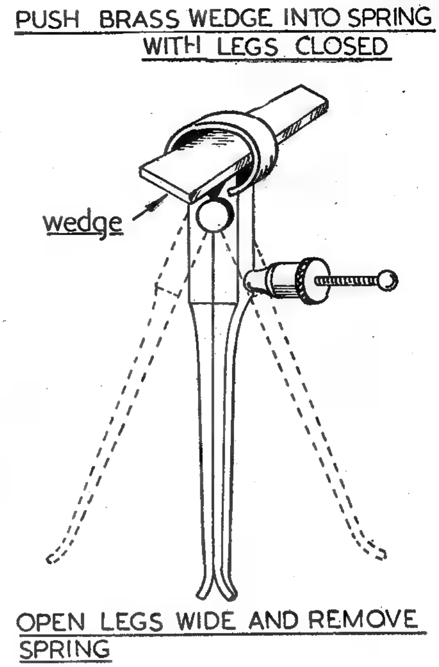


Fig. 5. *Showing method of removing the bow spring*

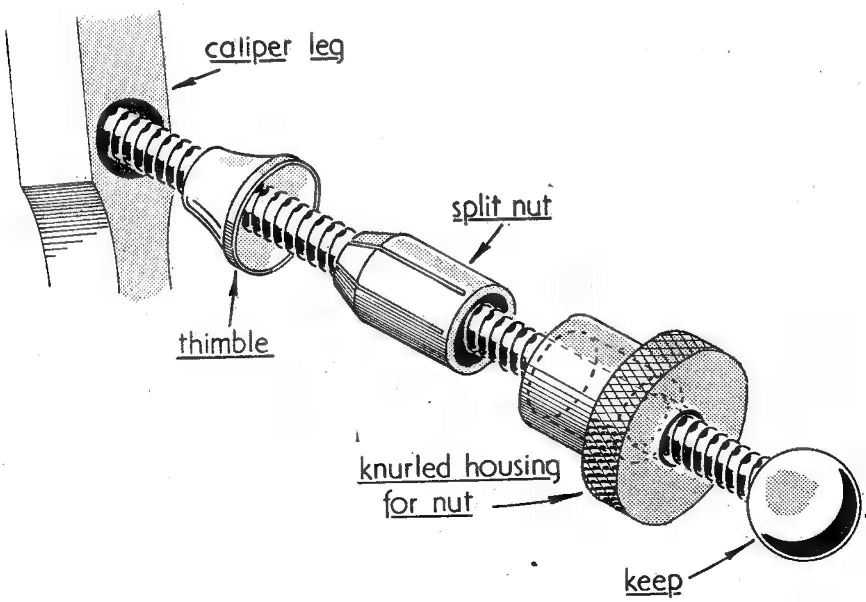


Fig. 6. *Illustrating the construction of ■ quick-acting adjustment nut*

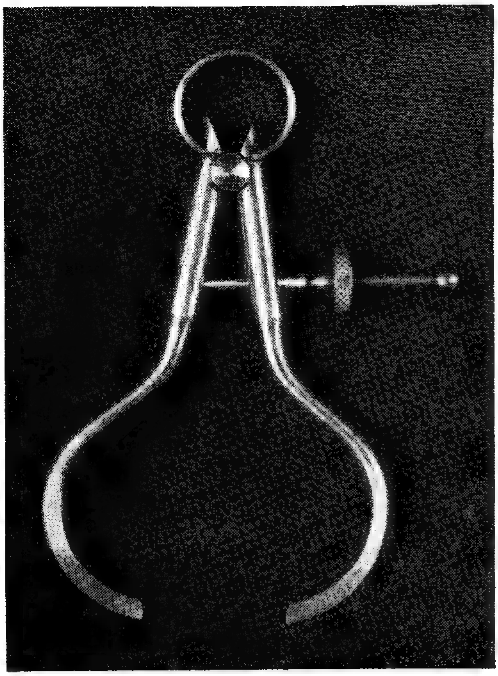


Fig. 6, will make clear the method of construction; when the legs are pressed together, the split, threaded portion of the nut is allowed to expand and clear the threads on the screw ; this enables the nut to slide along the screw and the legs to open. When the legs are released, the sliding thimble again compresses the nut, so that it [redacted] more grips the screw threads.

Toolmakers' Calipers

For small work and to afford more sensitive handling, [redacted] set of toolmakers' calipers is obtainable in inside, outside, and dividers form. These, [redacted] illustrated in Fig. 7, have the legs made from round material flattened towards the tips. The usual form of spring joint and adjustment screw with solid nut are fitted, but these parts are smaller and the screw is of finer pitch. The set of these calipers at present in use, made by Messrs. Starrett, is of the 2 in. size, and in this small form the calipers are most convenient to handle, but larger sizes up to 6 in. are made by this firm. Messrs. Moore and Wright manufacture a range of toolmakers' calipers in the 3 in. size.

In [redacted] following article some hints will be given on the methods of using the various types of calipers described.

Left—Fig. 7. Toolmaker's pattern of outside calipers

The Allchin "M.E." Traction Engine—and [redacted] Note to Fowler Fans

by W. J. Hughes

THE fourth sheet of details for the Allchin "M.E." $1\frac{1}{2}$-in. scale traction engine is now ready. It includes all details of the hind wheels, including rims, strakes, hubs and spokes, of the driving-bosses and driving-pins, and the winding-drum. Full details of the compensating-gear or differential are also included. The drawing is No. T.E.11 (Sheet 4).

Castings

Patterns [redacted] well in hand, and it is anticipated that very [redacted] of the castings will be ready, so that those who wish to get [redacted] with the job by themselves will be able to do so, without waiting for the "instructional" articles which [redacted] to follow when space permits. Reeves of Birmingham [redacted] doing the needful, by the way, [redacted] do [redacted] write to [redacted] about them!

The Fowler Showman's Engine

A number of readers have written deploring the fact that my drawing of the Fowler "Big Lion" road locomotive does not include showman's fittings.

However, through the courtesy of Messrs. J. & H. McLaren Ltd. I have now obtained what I wanted—*official* Fowler drawings of the fittings. These are drawn to various scales, and [redacted] soon [redacted] it has been possible to re-draw them all to $1\frac{1}{2}$-in. scale, a further announcement will be made.

Meantime, those Fowler fans who want to build [redacted] showman's engine [redacted] do [redacted] in the knowledge that when they want particulars of crane, canopy, dynamo platform, and [redacted] on, the said particulars will be available. But a word of warning in advance! Do not make [redacted] fit either the smokebox [redacted] the bunker yet! *Verb sap.*

A Marine Engine Crankshaft

by A. G. Hann

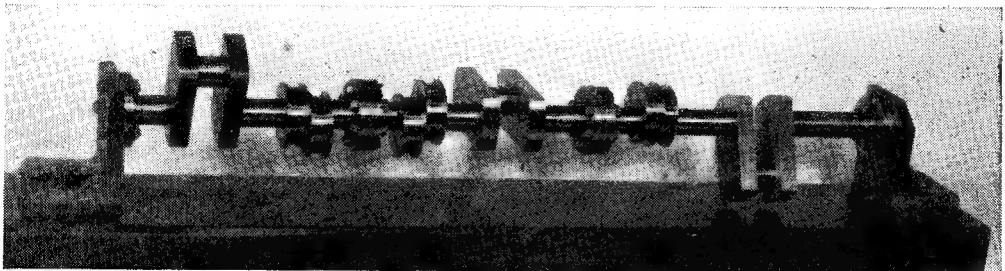
THE accompanying photograph is one of a marine engine crankshaft, which I have made recently, and whose construction is rather unorthodox in so far as the crank webs, and eccentrics, were turned integral with the shaft sections, six in number, the crankpins being separate items.

The dimensions of the shaft are: overall length $13\frac{5}{8}$ in., diameter of shaft $\frac{1}{2}$ in., throw of cranks 1 in., throw of eccentrics $\frac{3}{16}$ in., webs [illegible] in. long × 1 in. wide × $\frac{5}{16}$ in. thick. The weight of the finished shaft is $2\frac{1}{4}$ lb., and the weight of metal removed from the original steel bar was $19\frac{1}{2}$ lb. The time taken to make the shaft, was in the neighbourhood of 300 hours.

The method of construction was as follows:—

From a length of $2\frac{1}{2}$ in. diameter mild steel, six pieces were cut (with a hand hacksaw !) and both ends of each piece were faced, using a four-jaw chuck. Tinplate templates were then made, one for each of the three shaft sections carrying eccentrics, and one for the other three sections. These templates were all marked with shaft and web centres, and on three, ahead and astern eccentric pulley centres were also marked. The centres were drilled through, with a fine drill, and the templates were used to centre-pop the various centres on to the shaft stock, at both ends. A $\frac{1}{4}$ in. hole, about 1 in. deep, was drilled in both ends of each piece, the purpose of which was for the engagement of a pin, secured to the faceplate, which provided the necessary drive. The six pieces were drilled with a centring drill at all the pop marks, and were then turned in the normal way. As there was about $1\frac{1}{2}$ in. of overhang, or eccentricity, when the shaft portions proper were being turned, light cuts only could be taken. Also, as the coupling flanges and crank-webs were, in some cases, very close to each other, and to the eccentrics, only a small quantity of metal could be removed, before it was necessary to remove the round nose tool and substitute knife tools, to clean up the sides of the recesses being made.

As it was necessary that the eccentrics should be parallel with each other, and in the same plane as the webs and coupling flanges, the method employed was, as the very first turning operation, to take a facing cut across both ends of each piece, while the pieces were mounted in the shaft centres, thus ensuring at the outset, that the ends were parallel with each other, and at right angles to the axis of the shaft. Reference was made to these faces while turning the eccentrics, and, when necessary, adjustment of the pieces



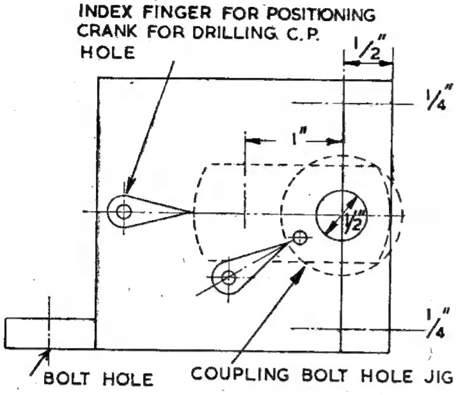
P hoto by] *[H. Penhaul*

The finished crankshaft

being turned was made, by packing, in the headstock centre. The eccentrics were rough turned first, leaving a fin of metal (about 1/32 in.) where the adjacent faces of ahead and astern eccentrics would come, which fin was, really, a portion of the eccentric flanges in the making. Reference to this fin and the faced ends was made for the adjustment already mentioned, as the possibility of error would be less when setting up from this fin, than from the much smaller face of the eccentric. The webs were machined to the shape required on a hand shaper. For this operation, a special jig was made from a casting specially designed for the purpose (see drawing). This jig was also provided with an attachment, which guided a pilot drill for the crankpin holes, and the design permitted the holding, marking and drilling out to $\frac{7}{16}$ in., of the crankpin holes, at one setting. After this operation, the two sections of shaft, forming one complete crank, were set up together in a simple jig mounted on the vertical slide on the lathe, and the crankpin holes were bored out to finished size—15/32 in.

Crankpins were turned $\frac{1}{2}$ in. diameter, with a reduced diameter of 15/32 in. at the ends, so that when assembled, the pins were prevented from lateral movement by the shoulders thus formed. The ends of the crankpins were flush with the outer faces of the webs, to ensure which, a simple depthing gauge was made. The pins were turned a good hand tight fit in the web holes, up to within 5/32 in. of the shoulders, and this 5/32 in. was left about 0.001 in. oversize. The pins were put on by hand, as far as possible, crank-webs set parallel and a machine vice then used to press the pins home, perfectly tight and rigid cranks resulting. Coupling bolt holes

were drilled, by means of a steel "cap" jig, which fitted over the flanges, and had six equidistant index lines, marked round its edge, and one drilled pilot hole. Originally, six pilot holes

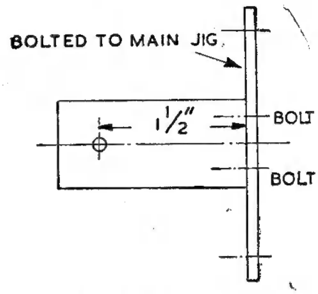


Plan of main jig

were made in the jig, but owing to an error in the spacing of one of them, this idea was abandoned, and the method of using one hole, and revolving the jig round on the flange, setting the index lines to a fixed pointer secured on the main jig, was adopted. Coupling bolts were made and fitted, although for one set, studs had to be used, as it was not possible to put bolts in—the flanges being too close to the webs and eccentrics.

As it was undesirable that the various centres, used during turning operations, should appear on the finished shaft; the shaft sections were all cut about $\frac{1}{2}$ in. too long, the various centres being drilled to a depth of $\frac{1}{4}$ in., so that, apart from the actual shaft centres, which were drilled deeper, and deliberately left *in situ*, all centres were turned off, during the final facing of the section ends.

Contrary to the popular "saw" that, for a good finish, one should use a fast speed and a fine feed,



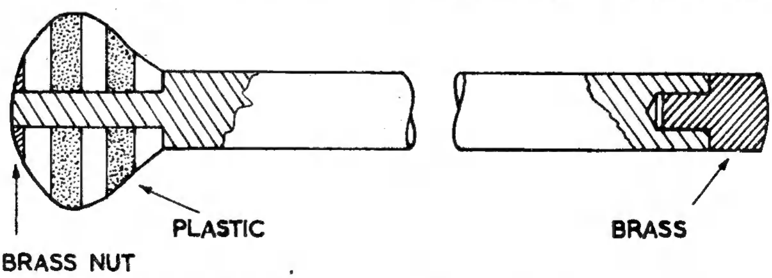
Crankpin hole drilling jig

I found that an excellent finish was best obtained with the lathe running at the second of the three speeds, with back gear in. The lubricant used was soda water.

Finally, may I add that, while fully aware of the disadvantage of having the eccentrics non-adjustable, I made them so, as being the only alternative, except for one of the several "codged up" arrangements, favoured by some model makers to the full size practice of using split and keyed eccentrics, which, for eccentrics of 1 in. diameter, was hardly a practical proposition.

A BUMPER-OUTER

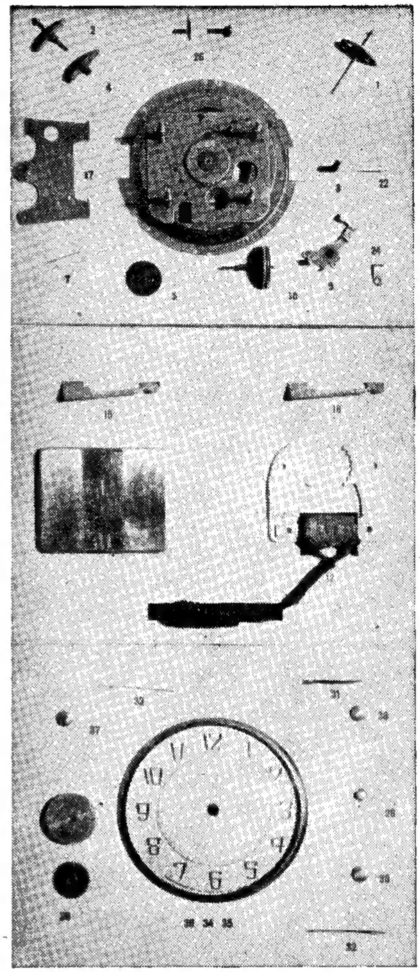
MOST amateur turners seem to use any old bit of rod for knocking out centres. Not much wrong with this I suppose, but in the long run there is a risk of damage to the bore.



As a stage better, I have devised this bumper-outer. The shaft is a piece of bright-drawn mild-steel, $\frac{9}{16}$ in. diameter, a little longer than necessary for the headstock and, therefore, ample for the tailstock of my M.L.7 lathe. At the end that does the hitting is a brass pad, with a lug fitting into a hole in the end of the steel.

For a handle at the other end I reduced the bar to $\frac{1}{4}$ in. for about an inch, screwed its end, and slipped on some oddments of plastic, which were then squeezed tight by a brass nut. All of this, including the nut, was turned to a comfortable shape and polished—so that bumping-out is now a pleasure.—P.W.B.

A Synchronous Clock Constructional Kit



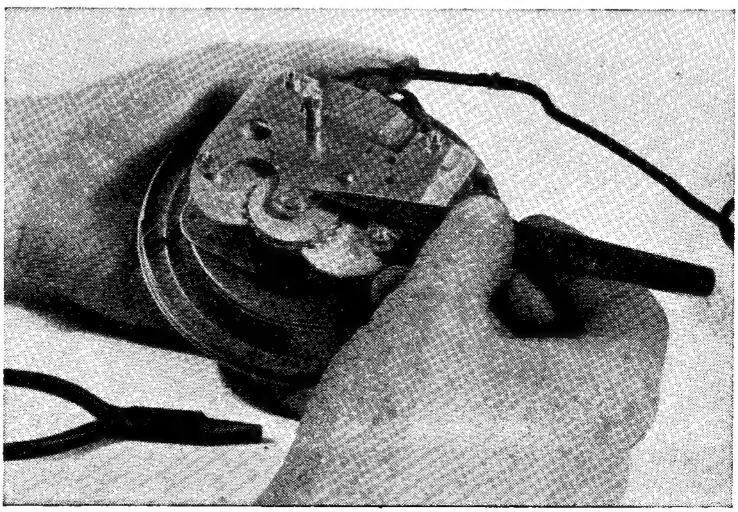
THE gradual reappearance in the shops of constructional kits is welcomed by boys of all ages. Admittedly, some follow the same theme, but excesses in this respect lead one to study with greater interest the more unusual type of kit. Such a case is that of the Adieclock constructional kit, which consists of a complete set of parts to construct a 200-250 volt a.c. mains synchronous clock movement, including the dial, hands and bezel.

The first photograph shows the complete set of parts as supplied in the kit, the assembly of which was then undertaken in the "M.E." workshop. An illustrated instruction leaflet is included in the kit, with the sequence of assembly clearly marked, and very little difficulty was encountered during the assembly. However, we do not quite agree with the implication made by the makers that the kit is suitable for boys from 6 to 60: we are extremely doubtful whether the average child of *six* would be able to carry out the assembly work successfully, but on the other hand, we see no reason for the upper age limit.

A Small Fault

During assembly it was found that the back plate securing-nuts would not go on the threaded pillars until the leading threads had been cleaned up with an appropriate die. This annoying fault could be obviated by improved shaping of each pillar at the start of the thread. The second photograph shows the movement from the rear during the later stages of assembly.

The assembled movement was connected to 230-volt, a.c. supply and after the necessary initial adjustment of the pole-pieces was carried out ran successfully. A certain amount of noise was apparent, but quite in keeping with the type of movement. A good feature is the provision of a centre-seconds hand—an instant indicator of current failure. The rotor is non-self-starting, a spring-loaded "turn and release" knob being fitted to provide the initial spin.

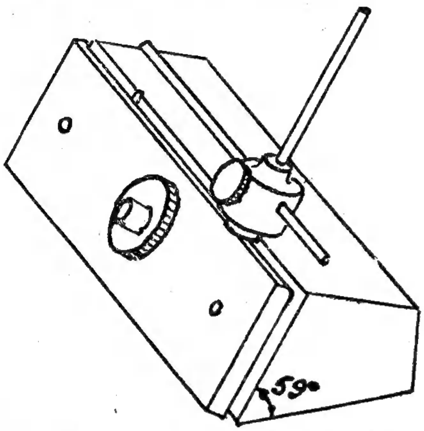


The kit is produced by Metalair Ltd., of Wokingham, Berks, and is on sale in model shops. A clock case is not included.

PRACTICAL LETTERS

Sharpening Small Drills

DEAR SIR,—Some months ago I made a drill-honing aid from a description in your columns, but I was never quite happy with it. I found it tiresome to adjust the facets of small drills of No. 55 and smaller. Having sharpened one facet, the second required the same careful adjustment.



Later, Mr. J.C.B.'s variation was described, and as this seemed to be a considerable improvement I made one forthwith, excepting the length stop, as I felt that correct length without correct angle would be a job half done. Instead, I made a collar drilled to take a ⅛-in. drill, the hole being grooved with a 3-square file. Opposite the groove is a knurled screw, and at right-angles to these, a sighting rod of 3/32 in. steel. A small drill gripped in the collar is now easily adjusted, the base clamping-screw is tightened, the collar screw released and the collar lowered to rest on the base and then tightened again, having the rod parallel with the base. After sharpening one facet, the base-screw is released and the collar rotated to the new position.

Yours faithfully,

Sandgate. KENELM ARMYTAGE.

Rust Prevention

DEAR SIR,—I am very grateful to "Physicist" for the interest that he has displayed, in this problem of combating rust.

I am conversant with both lanolin in solution and silica gel. My experience with lanolin is that it is ideal if one can slightly warm the article (which at the same time drys it) and then dip the article or paint it over with the solution, and hang it up in such a way that it can touch nothing and nothing can touch it. If by some accident or other the thin film is in anyway damaged, then the rusting that takes place seems to be accelerated in that one spot.

I must say that at the time we were living on a cliff top where the breezes were laden with salt water particles.

The method (2) specified by the writer, appears to me to be exactly what I require, particularly the flexible one.

"Physicist" is correct when he says perhaps Mr. Searles has something he especially values. This particular thing is a South Bend lathe, 9 in., and three and half foot bed, with most accessories that are necessary for obtaining the most out of the lathe. When I proceed on leave I must either bring it with me or leave it packed up here to be shipped on to me when I arrive at my next station. In either case it will be a matter of six to eight months, and I foresee that I shall have to do a really thorough job of enveloping all the bright parts if I am to be entirely satisfied with the condition of the lathe when we next meet.

I should be very much obliged indeed to know more about tropical packing and the materials necessary for same, with a view to obtaining them here in Brazil and making them up myself into a V.P.I. material. I should prefer that it could be handled with impunity once it is applied, and yet easy to remove with the necessary solvent.

I greatly appreciate "Physicist's" offer to give me names and addresses, and shall be grateful for these.

It is finally my desire when packing the lathe to put it in as small a case as possible, with the motor drive and countershaft in yet another case and all the etceteras in a third case. To repack it as it came all in one case needs several men to move it, and in the method I outline I hope to have it so that two people can easily move any one case.

I have heard of a substance called Pliofilm into which the whole article can be placed, but whether this calls for any particular preparation of the article before enclosing it I do not know. Perhaps "Physicist" might know about this?

I thank you for publishing my original letter and hope that other people derive as much benefit as I hope to.

Yours faithfully,

Brazil. E. A. SEARLES.

Nuts and Bolts

DEAR SIR,—Referring to a query "Nuts and Bolts" in the November 2nd issue by A.W.T.; in the aircraft industry a pigmented varnish jointing compound is used when dissimilar metals have to be joined together. There are two specifications, as far as I know DTD 369 and 369A, the latter being supplied in tubes under the trade name of DURALAC made by Messrs. Llewellyn Ryland Ltd., Birmingham.

Some time ago the Air Ministry carried out experiments with two discs of dissimilar metals and a nut and bolt. The conclusion derived from these experiments is that it is just as safe in practice to have contact between two dissimilar metals as between two pieces of the same metal.

Hoping this might be of some help, as so many of your reader's letter have been to me.

Yours faithfully,

Sidmouth. A. C. WHEATEY

Re Carbon Arc

DEAR SIR,—With reference to query No. 9870, by "F.W.N.S." (Yorks), my experience may be of interest to the querist, as I have used a powerful carbon arc lamp for some years.

I constructed a clinic sized lamp with three pairs of iron-cored carbons wired in series; this eliminated the need for a transformer, and by means of a well insulated lever, the three arcs can be struck simultaneously. By having *three* pairs, most of the available voltage was utilised and the light output so increased as to shorten the time of exposure of the subject to one-third the time, should only one arc be used. Thus, the first dose would be 3 min., on any one skin surface, at a distance of 3 ft. from the lamp. Then 2-3 days later (after any erythema has faded) the second dose could be 5 min. back and 5 min. front, gradually increasing each dose by a couple of minutes and working up to what is probably a maximum dose of 25 to 30 min. This produces, besides its desirable tonic effect, the bronze tan required by F.W.N.S., and its heat is very welcome in the winter months.

Care must be taken with the dosage; fair skinned persons are sensitive to U.V.R. and also painful wounds or burns can be caused by overdosage. The eyes *must* be protected by the proper dark green glass goggles which must fit so as to completely exclude the rays from the lamp, *and* its reflections off other objects in the room. *You have been warned*!

If it is not desired to make the lamp, it can be obtained, I believe, from Messrs. The Medical Supply Association, London, also the carbons.

The current taken is about 25 A when running, thus costing (with electricity at 1s. per unit) about 6s. per hour. On striking the arcs, the current will momentarily be high, but my 60 A fuses have stood it for five to six years. The carbons are ¾ in. diameter, technically known as "White Flame Iron bored." There is a large choke coil which limits the "juice" and absorbs the extra voltage. Each pair appears to need 60-70 V, so three pairs in series will take about 200 V, and the remainder is absorbed by the choke. (My mains are 230 V a.c., 50 cycle.)

If your querist or others require any further details I will be glad to give same.

Yours faithfully,

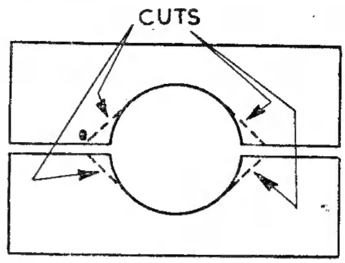
Barry. G.F.L.R.

Modifications to A 3½ in. Drummond Lathe

DEAR SIR,—With reference to Mr. T. R. Frank's letter in your November 2nd issue, I think he will overcome the clasp-nut clearance difficulty by "cutting the corners" as shown in the sketch herewith.

I made up the fitment to Mr. Lloyd's excellent design some years ago, and with certain modifications, it has given good service. Fortunately I noted the T-piece dimension error in good time!

The modifications I made to suit my own purposes, and they were certainly not improvements on the original design. For example, the rack was made from a curved steel fanlight opener. This ready-made rack was straightened, when red hot, inch by inch. The bronze gear attached to the cord pulley was used as the rack pinion, and the rack gearing was freely adapted from the contents of an old Douglas motor-cycle gear-box. The traversing wheel is from a set of lathe castings I bought through THE MODEL ENGINEER just after World War I. The spring stops for the clasp-nut lever consist of cupboard-door ball catches.



I can well appreciate Mr. Frank's complaint on the subject of material shortage—I had the same difficulty, and on the evening I finished marking-out the plates, Hitler sent over his first VI, occasioning further delay!

Yours faithfully,

Sanderstead. FREDK. E. DEAN.

The Reason for Two Cylinders

DEAR SIR,—In reply to the query by J. L. Hartshorne "Why Only Two Cylinders," I am sorry he regrets the omission of the inside cylinder, but like J.L.H., I also am short of spare-time, and also have several irons in the fire. I omitted the inside cylinder preferring to use the time so gained by putting extra care and finish into the rest of the work. You see, I have two hobbies, photography and model engineering, and devote time to each. Again, apart from amusing myself, I must think about Mrs. Plummer, and for this reason the Refrigerator by L. C. Sherrell is also under construction.

There are so many things one would wish to do and make, but as "L.B.S.C." says "life's mighty short."

Yours faithfully,

Norton-on-Tees. SYD PLUMMER.

Truing-up the Headstock

DEAR SIR,—Regarding Query No. 9855 R. P. Porthcawl in the November 9th issue, in nine cases out of ten where lathes turn taper, it is due, not to the fault of the headstock being out of alignment with the lathe, but to the fact that the lathe is bolted down on to an uneven surface. If R.P., before adjusting his lathe headstock, slackens the holding-down bolts and carries out your instructions with his dial indicator, he may save himself a lot of work. A piece of slimstone under one of the feet is usually sufficient to put matters right.

Yours faithfully,

Derby. T. N. DAVIES.